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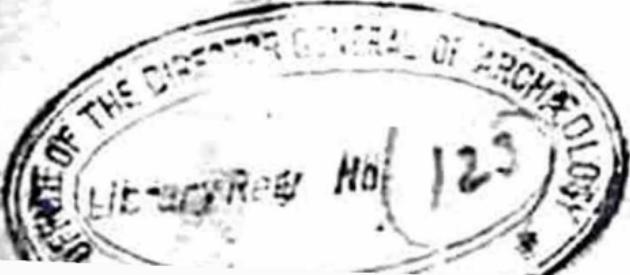
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HISTORY OF HINDU CHEMISTRY

V.12



A
HISTORY OF HINDU CHEMISTRY

FROM

**THE EARLIEST TIMES TO THE MIDDLE OF THE
SIXTEENTH CENTURY A. D.**

WITH

8865

**SANSKRIT TEXTS, VARIANTS, TRANSLATION
AND ILLUSTRATIONS**

BY

SIR PRAFULLA CHANDRA RAY, Kt., D.Sc., Ph.D.
Prof. of Chemistry, University College of Science, Calcutta.

VOL. II

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To the Memory of
M. P. E. BERTHELOT
I dedicate this volume of the History
of Hindu Chemistry.



PREFACE

The second and concluding volume of the *History of Hindu Chemistry* is now presented to the public.

When the first volume was under preparation, it was feared that many valuable works on Hindu Chemistry referred to in Rasārṇava, Rasaratna-samuchchaya, etc., had been lost for ever. Pandit Navakānta Kavibhūshana was deputed to Benares to make a searching enquiry and his labours have been rewarded by the discovery of several rare MSS., including one of Rasabhrdaya. This last-named work is of surpassing interest considering its comprehensiveness and antiquity. Two more transcripts of it have also been procured from the Libraries of the India Office, London, and of the Darbār, Nepal. A copy of Rasendra-chūḍāmāni obtained from the Library of the Deccan College, Poona, has also been of signal help. A critical study of the new materials throws a flood of light on the dark recesses of the history of Indian Chemistry. As a halo of literary and scientific activity including the pursuit of alchemy circles round the prominent figure of Nīgārjuna, considerable space has been devoted to a discussion of his age in the Historical Introduction.

PREFACE

It was with diffidence and hesitation that I placed the remotest limit of alchemical *Tantras* in the 12th century A. D. It now transpires that this date is to be pushed back by several centuries.

A *History of Hindu Chemistry* would be rightly regarded as incomplete which did not deal with the constitution of matter and the various hypotheses in regard to it. The European historian of chemistry has always turned his eyes to Greece as the perennial fountain of knowledge on this as on other subjects. And it is but natural that he should do so. * The Hindu atomistic school has not hitherto, I am afraid, found an interpreter who could do full justice to it. Colebrooke's presentation of it with which I had to content myself in the first volume is masterly so far as it goes, but is fragmentary. Not feeling myself equal to the task I applied for help to Mr. Brajendra Nath Seal Principal, Victoria College, Cooch Behar. Principal Seal has kindly responded to my appeal with alacrity. It is to be hoped that a long-felt *desideratum* has at last been supplied.

The frequent references which have been made to the first volume must be taken to mean the second edition of it. Those who happen to possess copies of the first edition will not, however, be put to any serious inconvenience.

* *Vide Vol. I, Intro. xlvi.*

PREFACE

I avail myself of this opportunity to express my cordial thanks to Pandit Harischandra Kaviratna late Professor of Sanskrit, Presidency College, and my collaborator in the editing of the text of *Rasarnava* in the *Bibliotheca Indica* series.

In the preface to the first volume I presumed to narrate the circumstances under which I undertook the composition of my History. The great chemist and savant, whose inspiration has been my guiding principle throughout the arduous task and whose lengthy and appreciative review of the first instalment has been a stimulus in the continuation of it is no more. Marcellin Berthelot breathed his last on March 18, 1907, leaving the world of science poor indeed. It was with the view of coming into personal contact with the illustrious scientist that the author made a pilgrimage to Paris in March, 1905. The long interview which he had with M. Berthelot and the reception which was accorded to him at a meeting of the Academy of Sciences by its late Perpetual Secretary, as also by its President M. Troost, made a deep and lasting impression on his mind.

Alas, for the vanity of human wishes ! These pages will no longer be greeted by the eager and indulgent eyes of M. Berthelot. All that now remains for me is to dedicate this volume to his sacred memory.

It is with mingled feelings that I mark the hour of my final deliverance from a self-imposed task which has occupied all my spare time during the last 15 years and more—feelings not unlike those which overpowered the Historian of the Roman Empire. The reader will, I hope, forgive me if I venture to give expression to them in the words of Edmund Gibbon himself. “I will not dissemble the first emotions of joy on the recovery of my freedom. * * * * But my pride was soon humbled, and a sober melancholy was spread over my mind, by the idea that I had taken an everlasting leave of an old and agreeable companion.”

The Hindu nation with its glorious past and vast latent potentialities may yet look forward to a still more glorious future, and, if the perusal of these pages will have the effect of stimulating my countrymen to strive for regaining their old position in the intellectual hierarchy of nations, I shall not have laboured in vain.

PRESIDENCY COLLEGE

P. C. RAY.

June 1, 1909.

PRELIMINARY REMARKS ON THE MECHANICAL, PHYSICAL AND CHEMICAL THEORIES OF THE ANCIENT HINDUS.

My paper on the *Mechanical, Physical and Chemical Theories of the Ancient Hindus* is intended to be a synoptic view of the entire field of Hindu Physico-chemical Science, so far as this reached the stage of positive Science as distinguished from the prior mythological and empirical stages. As the work in which my paper appears relates to Hindu Chemistry, I have elaborated the chemical portions, including the Hindu account of the constitution of the fats and oils and the organic tissues in addition to Hindu inorganic chemistry. I have also briefly noticed the chief chemical industries of the Hindus which secured them an easy pre-eminence in manufactures for a thousand years, and, in the *Addenda*, given some interesting recipes relating to several matters of chemical technology. Of mechanico-physical theories, I have expounded the Hindu conception of Energy, potential as well as kinetic, and of molecular motion, so far as they are applied to the elucidation of problems of a physico-chemical nature, viz., the constitution of

PREFACE

matter, the genesis of atoms and their infra-atomic constituents, and the chain of mechanical causation in the system of Nature. I have also touched on the Hindu theories of light, heat and sound, as implying current or wave motion, leaving the elaborate exposition to my paper on Hindu Mechanics and Physics. In the *Appendix*, I have added a brief account of the Scientific Method of the Hindus, which shows that all this was not a mass of unverified and unverifiable speculation (the very antipodes of science).—the charge usually brought against Hindu thought and culture,—but professed to be the outcome of a Scientific Methodology which, in its formulation of the canons of the two fundamental Inductive Methods, is more comprehensive as well as more original and suggestive than Mill, and which, as regards its Applied Logic of the Sciences, (*e.g.* the Logic of Therapeutics, of Grammar *etc.*), is a standing testimony to the systematic completeness and rigour of the Hindu scientific mind. The difficulties of my task have been formidable, but I have not written one line which is not supported by the clearest and most authoritative texts. The ground trodden is, for the most part, absolutely new. I have gone back to the *origines*, and studied the authorities at first hand, being resolved to eschew all second-hand sources of information. Fortunately the Sanskrit philosophico scientific terminology,

however difficult from its technical character, is exceedingly precise, consistent and expressive. The materials also are full and the sources of information corroborate one another. Another difficulty I have sought to guard myself against is the unscientific, unhistorical but very common and almost inevitable habit of reading modern ideas into old guesses or speculations of a happy-go-lucky or nebulous character. I do not think that the mere passion for Truth is a sufficient safeguard against this fatal facility of unconscious distortion or misrepresentation. A true historical perspective can only be acquired by historico-comparative studies, with the application of the correct historico-comparative method (*vide* the Introduction to my Comparative Studies in Vaishnavism and Christianity). I have also practised, or tried to practise, a habitual understatement, without consciously falling into that '*suppasio veri*' which is so often a '*suggestio falsi*.' How far I have succeeded in exhibiting the truth about Hindu science or the Hindu scientific mind is a question which I leave to competent judges to answer.

Before concluding, I must advert to my use of the terms "isomeric" and "polymeric" in senses different from the current ones, though suggested by the principle of analogous extension. Instead of coining new terms, I adopted (perhaps with a questionable freedom) these existing ones to ex-

press the Hindu idea of distinctions of chemical substances due merely to difference in spatial position or arrangement among the particles, without any implications whatever as to percentage composition or molecular weight. A study of the original sources has made it clear to me that a "Bhūta" in Hindu Chemistry represents a class of elements composed of similar atoms, and the different elementary substances comprised under one and the same "Bhūta" are 'isomers', in this limited sense, in reference to the atoms, being specifically constituted by differences of spatial position and arrangement among the latter. This is true of the Sāṅkhya-Pātanjala and the Nyāya-Vaisesika alike. But in the Sāṅkhya-Pātanjala, the atoms themselves are composed of Taumátras; and in one view, the atoms that enter into the "isomeric" modes of the same "Bhūta" are themselves "stereo-isomers" in reference to the Taumátras. A tri-Taumátric atom, for example may have different isomeric forms which would account for the divers modes of the "Bhūta" originating with this class of atoms. Hence under the Sāṅkhya Pātanjala, I speak of "isomeric" atoms, while under the Nyāya-Vaisesika I confine myself to the phrase "isomeric modes of the same Bhūta". It appears to me also that in the Sāṅkhya-Pātanjala view, while an atom of a particular kind (say a tri-Taumátric or a tetra-Taumátric one) may have "isomeric" forms of its own, the

atoms of the different "Bhūta" classes (from the mono-Tanmātric to the penta-Tanmātric) are what may in a broad sense be termed polymers of the Akāsa Tanmātra and Bhūtādi (matter-rudiment). Under the Sāṅkhya-Pātanjali, therefore, I have spoken of "polymeric" atoms and "polymeric" combinations of these, though I must confess that I have done so with great diffidence and hesitation.

VICTORIA COLLEGE,

COOCH BEHAR.

23rd May, 1909.

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B. N. SEAL.

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Introduction

CHAPTER I

On the age of Nagarjuna and the Buddhist Alchemical Tantras.

In the first Volume it has been incidentally mentioned that side by side with the Sivaite Tantras we have their Buddhist counterparts in which the salient features of the former appear. • The question now arises : when did the votaries of the religion of Sakyamuni find themselves called upon to engraft upon their simple and pure creed the *ensemble* of the gross and grotesque superstitions, the hideous incantations, as also the speculative, the metaphysical and esoteric phases of spiritual aspirations of which the Tantras are the repositories ? The answer cannot be given off-hand

Rise, development and propagation of Mahayāvinism.

in a few words, for it will lead us to a discussion of the origin and development of Mahāyānism. Under ordinary circumstances we should have considered it beside our purpose to devote much space to this subject in a work dealing with the history of chemistry. But it so happens that the most prominent figure in Indian alchemy, who is acknowledged on all hands to be the discoverer of the processes of distillation, sublimation etc., is no other than the reputed founder of the Mādhyamika system of philosophy, the renowned Nāgārjuna. A brief and rapid survey of the causes which led to the origin of Mahāyānism and its intimate connection with the tenets of the Sivaite cult will be of help to us.

It is one of the saddest episodes in the history of the great religions of the world that the purity of life, right conduct, right living —in short, the moral code upon which their founders have always laid particular stress, soon begin to occupy a subordinate position and a dogmatic theology springs up in time, which gives occupation to the subtlest intellect.

As for the masses of the people it is doubtful if ever they have remained contented with the mere ethical aspect of a religion. At any rate we find that immediately after the tidings of the death of Buddha had spread about there was a squabble among his followers for the possession of the master's corporeal relics and in course of time stupas were raised over them, which no less than the three jewels (*Ratnatraya*)—the Buddha, the Dharma and the Samgha,—and the Bodhi-tree became objects of worship of the devotee. The Chaityas, Vihāras and other sanctuaries of divers sorts, with which Buddhistic India was dotted over in the first and second centuries after the decease of the great teacher, afforded asylums for a vast multitude of monks, who, freed from all worldly cares, found ample leisure to formulate and draw up a code of spiritual and disciplinary exercises.

Although their high ideal was "to lead sweet lives of purest chastity" and induce their lay brethren to follow in their footsteps, rituals and ceremonials of an imposing and

elaborate character soon obscured the ray of light which shone forth from the founder. Thus we find that within 150 years after the passing away of Buddha tedious and circumstantial regulations as to the quality of robes to be worn by the Bhikshus, the mode of bathing and fasting, the taking of the midday meal, the drinking of unchurned milk, probation and penance, dwellings and furniture and so forth were amongst the weighty subjects for discussion in the Second General Council. We need not pursue the subject further. The reader who is interested in the study of comparative religions will find striking parallels in the early history of the Christian Church.^t

• "On the daily Life of the Bhikshus". Vinaya Texts (S. B. E. Series). The Chullavagga, Pt. iii, p. 66.

† The Sermon on the Mount was more or less forgotten. Idolatry disappeared, it is true, but only to reappear in the shape of Mariolatry and the worship of Saints and relic. In the heat of the schismatic strife, Christian Charity had to make shift for itself as best as it could. Theologians were busy with the interpretation of the writings of the fathers. In a word, the dogmatic to a large extent superseded the moral element of religion.

We are not concerned here with tracing the rise, progress or decline of Buddhism ; if we have at all referred to its excrescences, it is only to prepare the mind of the reader for the proper understanding of the Mahāyānist development.

The India of Asoka and of the fourth and third centuries B. C. was in the main Buddhist, but it should not for a moment be supposed that the old faith was extinct. The triumph and ascendancy of the teachings of Sākyamuni and his followers were due in a large measure to the fact that they drew upon, and incorporated into, their creed much that was essentially of Hindu origin. As Dr. Bhāskarīkar observes :—

* Prof. Rhys Davids expresses the same views in several places :—"There is ample evidence even in the books of the orthodox body of Brahman teachers to show that when Buddhism arose there was not only much discussion of the ultimate problems of life, and a keen interest in the result but also that there was a quite unusually open field for all sorts of speculations".—"Buddhism." American Lectures on the History of Religions (1898), p. 28. Again: "But Buddhism is essentially an Indian system. The Buddha himself was,

"But it was not the metaphysical doctrines of Buddhism that influenced the masses of the people. What proved attractive was its ethical side. The Buddhist preachers discoursed on Dharma or righteousness to the people. Such discourses on Dharma without the introduction of any theistic idea have their representatives in the Brahmanic literature. In many of the episodes of the Mahabharata especially in the Santi and Anusasanaika books we have

throughout his career, a characteristic Indian..... he was the greatest and wisest and best of Hindus."—*ibid.*, p. 117. The same high authority puts it more tersely when he says: "This is partly, no doubt, because we call them Buddhists, and imagine them, therefore, to belong to a separate class, quite distinct from other Indians of that stock. The Buddhists were, as a matter of fact, characteristically and distinctly Indian."—"Buddhist India," p. 185. Cf. "Buddhism, in fact, may be regarded as a reformed phase of Hindu religion and ethical activity. The Buddhistic doctrine of the vanity of the world had been thoroughly disseminated by Yajnavalkya (in the Satapatha Brâhmaṇa) and with it the practice of subsistence upon alms as Pravrajika or Bhikshu : and a fruitful soil had thereby been prepared for Buddhism". Weber's "Hist. Sans. Lit." trans. 3rd Ed. (1893) p. 285. Again 'This teaching contains, in itself, absolutely nothing new; on the contrary, it is essentially identical with the corresponding Brahminical doctrine; only the fashion in which Buddha proclaimed and disseminated it was something altogether novel and unwanted.'—*ibid.*, p. 289.

simply ethical discourses without any reference to 'God, of the nature of those we find in the Buddhistic works ; and sometimes the verses in the Mahâbhûrata are the same as those occurring in the latter. There appears to be at one time a period in which the thoughts of the Hindus were directed to the delineation of the right conduct in itself without any theistic learning. And Buddhism on its ethical scale represents that phase. Right conduct is the last of the four noble truths of Buddhism."

• • • • •

"It was this phase of Buddhism that with the strenuous efforts of the missionaries and of the Emperor Asoka enables it to achieve success amongst the masses of the people ; and what was wanting on the theistic side was supplied by the perfection and marvellous powers attributed to the founder of the religion. Without this faith in the perfection or, what we should call the divine nature of Buddha, a mere ethical religion would probably not have succeeded. Buddhism was not a social revolution as has been thought by some writers. It was a religion established and propagated by persons who had renounced the world and professed not to care for it. From times of old there existed in the Indian community such persons who were

called Sramanas and belonged originally to all castes. These gave themselves to contemplation and sometimes propounded doctrines of salvation not in harmony with the prevalent creed. Buddhism was not even a revolt against caste, for though men from all castes were admitted to the monastic order, and though in the discourses of Buddha himself and others the distinction of caste is pronounced to be entirely worthless, still the object of those who elaborated the system was not to level caste distinctions. They even left the domestic ceremonies of their followers to be performed according to the Vedic ritual. This is one of the arguments brought against Buddhism by Udayanāchārya. "There does not exist", he says, "a sect, the followers of which does not perform the Vedic rites beginning with Garbhādhāna and ending with the funeral, even though they regard them as having relative or tentative truth"⁴. Buddhism, however, was a revolt against the sacrificial system and denied the authority of the Vedas as calculated to point out the path to salvation. And

*मात्रेऽक्षरम् एव शोषत्मितदिक्षाय दर्शनाद्यस्त्रिपुरं-
पैदिकी विद्या अमी नामुत्तिष्ठति । Atmataittravireka, Calc. Ed. of
Samvat 1806, p. 19. शोषत्मि relating to शोषित a Buddhist techni-
cal term.

this is the root of the hostility between itself and Brahmanism."•

The zealous missionaries of Buddhism captured the heart of the masses by appealing to their more instinctive. Persuasion and not persecution was the instrument they chose to wield. King Asoka proclaimed universal toleration ; he inculcated respect for Brahmins as well as *Sramanas* or ascetics of all sects. It is a relief to find that the mighty monarch had never recourse to brute force for the propagation of his creed. We are spared all the scenes of blood, rapine and violence, which disfigure the pages of religious history in the West.

It has already been pointed out that Buddhism itself may be looked upon as an off-spring of Hinduism ; nay, it is a logical outcome of the principles enunciated in the

* "A peep into the Early History of India from the foundation of the Maurya Dynasty to the fall of the Imperial Gupta Dynasty" (B.C. 322—Circa 500 A. D.) pp. 362-363.

Journal of the Bombay branch of the Royal Asiatic Society (1900), Vol. xx. No. LVI.

Sāmkhya system of philosophy. If India so readily responded to the teachings of the new faith, it is not because she renounced Hinduism but because she found that all that was highest and noblest in the latter was absorbed in the former. The great Teacher who now arose gave only a new shape and direction and a vigorous impetus to the germ of ideas already in existence and turned them to capital account. A good deal of confusion may be avoided by bearing in mind this aspect of the question. When speaking of Buddhist India one is apt to rush to the conclusion that every vestige of Hinduism had disappeared off the face of the vast continent. As a matter of fact even during the zenith of Buddhistic glory Brahminism was rearing its head and was professed by not a few among the cultured and intellectual classes and was ready to assert itself whenever a favourable occasion arose.

In the second century B. C., we find the Kabul valley, the Punjab and Mālava ac-

knowledging the sway of the Princes of the Turkish race.♦ Wema Kadiphses, the second of the Kushana Dynasty is spoken of as a devotee of Mahesvara ; his coins bear the emblem of Nandin on the reverse, which is accompanied by a human figure which holds a trident in its right arm representing Siva. † The last three Kushanas—Kanishka, Huvishka and Vasudeva—have been noticed in the *Rājatarangini*,‡ and the emblems on the reverse of their coins are figures of deities borrowed from the Greek, Persian and Brahminical pantheon and of Buddha. Thus the Gods of all these four religions shared the adoration of these Turkish Kings. But the figure of Buddha in the

♦ Lassen "Indische Alterthumskunde," Vol. II, pp. 811-13 Ed. 1874.

† *Ibid.* pp. 808-811.

‡ See next page. Regarding the reliability of the account in the *Rājatarangini*, Dr. Stein observes :—"Kushana's account of the reign of these kings, who are supposed to have ruled simultaneously, is brief enough, but undoubtedly preserves data of genuine historical tradition. It clearly describes them as princes of Taruska, i.e., Turkish nationality, as powerful sovereigns and as faithful patrons of the Buddhist Church. On these points the statements of

sitting or meditative and the standing posture is to be found on the coins of Kanishka alone.♦

In the Buddhist ecclesiastical history Kanishka occupies a prominent place. It was in his reign and under his patronage that the Third Council was held to settle the canon once again. The church was convulsed by internal dissensions and schisms, resulting in its being split up into as many as 18 sects. "The most significant trait of the Third Council is that it closed a period of old quarrels between the sects ; it did not prevent the rise of new aspirations. Mahayāanism, which in an incipient stage was already existing ere long, boldly raised its head."†

the Chronicle are fully supported by the evidence of our most authentic records. The continued existence of the three places, Kanishkapura, Hushkapura, and Jushkapura, which are described as foundations of these kings and which still survive to the present day is likely to have assisted in preserving a recollection of their founders."

♦ Percy Gardner : "Coins of Greek and Scythic Kings" pp. 129 ff.

Cunningham : "Num. Chr." 1892, pp. 63 ff.

† Kern : Manual of Ind. Bud. (Grundriss d. Indo-Arischen Phil.) p. 122.

Hinduism was now very much alive. After the Third Council the distinction between the Hinayānists and the Mahāyānists became more and more accentuated. The apostles of the latter development became convinced that in order to draw into their folds the bulk of the people some sort of compromise was necessary, that orthodox Buddhism in all its rigidity must be given up. In other words, the neo-Buddhism which now sprang into existence began to absorb and assimilate the popular form of Brahminism and thus swell the ranks of its followers. A purely ethical creed has never secured a following except perhaps among a chosen few. To quote the eloquent words of the historian of "Rationalism in Europe":—

"There arise from time to time men who bear to the moral condition of their age much the same relations as men of genius bear to its intellectual condition. They anticipate the moral standard of a later age, cast abroad conceptions of disinterested virtue, of philanthropy, or of self-denial that seem to bear no relation to the spirit of their time, inculcate duties and suggest motives of action that

appear to most men altogether chimerical. Yet the magnetism of their perfection tells powerfully upon their contemporaries. An enthusiasm is kindled, a group of adherents is formed, and many are emancipated from the moral condition of their age. Yet the full effects of such a movement are but transient. The first enthusiasm dies away, surrounding circumstances resume their ascendancy, the pure faith is materialised, encrusted with conceptions that are alien to its nature, dislocated, and distorted till its first features have almost disappeared. The moral teaching being unsuited to the time becomes inoperative until its appropriate civilisation has dawned, or at most it faintly and imperfectly filters through an accumulation of dogmas, and thus accelerates in some measure the arrival of the condition it requires." Vol. i, p. 305, Ed 1900.

The same historian in explaining the rapid spread of Christianity in Europe observes in another place :—"It triumphed not so much by supereeding rival faiths as by absorbing and transforming them. Old systems, old rites, old images were grafted into the new belief, retaining much of their ancient character, but assuming new names and a new complexion."

Among the bold spirits who took a leading part in this renovation the name of Nāgārjuna stands conspicuous. The Mādhyamika system, with its axiom—*sarvam Sunyam*—a form of Pyrrhonism pushed to its extreme limits,

Nāgārjuna : a leading representative of Mahāyānism which is an essential part of Mahāyānism, is generally ascribed to him. Northern Buddhist literature is replete with the marvels and miracles performed by him, and tradition has invested him with superhuman powers. Hiouen Thsang calls him along with Deva, Asvaghosha and Kumāralabha, "as the four suns which illumine the world."• As early as A.D. 401-409 we find a life of Nāgārjuna Bodhisattva translated into Chinese.† Tāraśāmītha has committed to writing all the floating mass of legends connected with this venerable name, but as the Tibetan monk wrote so late as the beginning of the 17th century A.D., and as nothing was too astounding for his pious credulity, we have here only

• Jalleu's texts, Vol. ii, p. 214.

† Bus. Nanjio's Catalogue, Ap. i, No. 3.

nuclei of facts round which have gathered accretions of vast proportions. It is now almost a hopeless task to separate the grain from the chaff. Nevertheless we can glean certain historical data from all that have been handed down. Before proceeding further we think it proper to treat the reader to a specimen of the materials with which one has to deal. We cull the following bits from the "Life and Legends of Nāgārjuna" gathered chiefly from Tibetan records including Tāranātha's "History of Buddhism."

"A rich Brahmin of the Vidarbha country to whom no son had been born for many years, once saw in a vision, that if he gave alms to, and entertained one hundred Brahmins, he could get a son. Accordingly he made offerings and prayers to the God and entertained one hundred Brahmins. After ten months his wife gave birth to a son. The rich man invited learned astrologers to predict the fortunes of his child ; but they found that it could not live more than a week. In all other respects the child was calculated to be fortunate..... The astrologers assured them (his parents) that if they entertained one hundred Bhikshus, it would

live seven years, beyond which its life could not be prolonged by any means whatever. When the seventh year was about to expire the parents were overwhelmed with grief. To avoid the painful sight of their son's predicted death, they caused him to be removed to a certain solitary place in company with a few retainers.

"As the boy (Nāgarjuna) was passing his mournful days, one day the Mahābodhisattva Avalokiteśwara Khasarpana visited him in disguise and advised him to go to the great monastery of Nālendra in Magadha as the surest means of escaping from the hands of death. He accordingly repaired to that famous Vihāra and arriving at the gate recited some gāthās. During that time the great sage Sri Saraha Bhadra was the high priest of Nālendra, who ordained Nāgarjuna a Bhikshu of the Vihāra. * * * * During the latter part of his office the country was visited by a famine in consequence of which the monks fell into great distress. The Manager became very thoughtful about the terrible effects of the natural calamity. Distress and scarcity compelled the congregation more keenly to feel the necessity of money. The monks now determined to devise some means of acquiring treasures for the support

of the famished congregation, and Nāgarjuna accordingly started on an expedition to visit an island in the great ocean where lived a great saint well versed in the art of alchemy. As the sea could not be crossed by any earthly means, he, by dint of his divine learning, got two leaves of an enchanted tree, by means of which he crossed the ocean and miraculously visited the island and presented himself before the sage who was greatly surprised to see a human being arrived at his abode deemed inaccessible to mortal beings. The sage earnestly inquired how he succeeded in achieving this wonder. Nāgarjuna replied respectfully stating to him the reasons of his visit and circumstances that brought him thither. He also showed him one of the enchanted leaves, concealing the other in his mendicant's platter. He begged him to teach him the art of turning metals into gold. The sage consented to the proposal, but not liking to let the wonderful art be known in Jambudvīpa, he determined to detain him for ever in the island by depriving him of the enchanted leaf. To effect this, he said that he could not teach the art of alchemy unless Nāgarjuna consented to part with the leaf. Nāgarjuna consented, and was taught the art. When it was fully mastered, he flew towards the Indian Continent by the help

of the remaining leaf. Returning to Nālendra, by means of his easily acquired wealth he supported the whole body of monks. By his religious practices he obtained Siddhi (perfection). He refuted the theories of Samkarāchārya* and imparted religious instruction to the monks of Nālendra.

"Nāgārjuna returned to his country after a visit to Uttarakuru and erected many chaityas and temples, composed many works on science, medicine, astronomy and alchemy. After the death of Saraha Bhadra, the office of high priest fell upon Nāgārjuna, which he managed with great ability and indefatigable zeal. He matured the Mādhyamika philosophy which was only conceived by his illustrious teacher Saraha."

"Nāgārjuna is said to have been a great friend of king De-Chye (Samkara) of S. India, whom he converted to Buddhism."

* An instance of glaring anachronism. Samkara flourished in the 8th.—9th century A. D. See below, foot-note to p. xxii.

+ S. C. Das : Journ. As. Soc. li. Pt. i, pp. 115—120.

One thing seems to be clear from the above, namely, that Nāgārjuna was born and brought up in the Brahminical faith but was afterwards converted to Buddhism and was celebrated as an alchemist.

Tāraṇātha, it is true, completed his History in 1608 A. D., * but he derived his materials from Tibetan sources and the analysis of Dulva by Csoma goes to confirm this account. We have already made use of the record left us by Hiouen 'Thsang. † It is thus clear that all the testimonies concur in ascertaining Nāgārjuna not only as the originator of the Mādhyamika philosophy but also as an

Nāgārjuna as an
adept in magic
and alchemy.

adept in magic, conjuration and alchemy, and that even so early as the 7th century

A. D. The exact time during which he flourished is a matter of controversy. He is generally regarded as a contemporary of

* Siehe Sieber: Gesch. d. Bud. Pref. vi.

† Vide Vol. i, Intro. xciii.

Kanishka. One cannot go far wrong in assigning *circa* 150 A. D. as the date of his succeeding to the Patriarchate.

✓ According to Lassen Nágárjuna lived about A. D. 23 during the reign of Kanishka. The Rájatarangini says: "Then there were in this land three kings called Hushka, Jushka and Kanishka, who built three towns named after them (Hushkapura, Jushkapura and Kanishkapura)..... During the powerful reign of those [kings] the land of Kasmir was to a great extent, in the possession of the Buddhas. At that time 150 years had passed in this terrestrial world since the blessed Sákya Sírsha (Buddha) had obtained complete beatitude (Nirvána)..... And a Bodhisattva lived (then) in this country as the lord of the land, namely, the glorious Nágárjuna..... Stein's trans. Vol. I. pp 30—31. As the tradition of the Northern Buddhists as recorded by Hiouen 'Thaang (Si-yu-ki, 1. pp. 99, 161, the Tibetan Dulva (Cœura, As. Res. XX, pp. 82, 297) as also Schiefner (Tar. Gesch. d. Bud. p. 30!) concur in placing the commencement of Kanishka's rule 400 years after Buddha's Nirvána, the date assigned here to Nágárjuna is rather curious. Lassen sums up his conclusion on this knotty point in these words:—"Wegen der grossen Anzahl seiner Münzen muss dem Kanishka eine siemlich lange Regierung Zugeschrieben werden; ich glaube daher annehmen zu dürfen, dass er etwa bis 40 nach Chr. G. regiert habe." Fleet maintains B. C. 57. V. Smith c. 120 A. D. While Meers. Bháskarar c. 278 A. D. (Journ. Bombay Br. Roy. As. Soc. Vol. XX, No. lvi. pp. 259—395) as the date of Kanishka.

An important document has been preserved
to us in its Tibetan and Chinese versions,
which seems to have an historical basis. It
is in the shape of a "Friendly Epistle of
Nāgārjuna to king Udyana."•

Nāgārjuna as a
contemporary and
friend of king
Sādavāhana.

The original in Sanskrit, en-
titled *Suhṛllekha*, has not yet
been recovered and probably

been lost. Udyana in the Tibetan subscrip-
tion is Bdye-Spyod = Sadvāhana.† This Sad-
vāhana is a prominent figure in the history of
S. India. In ancient Sanskrit literature he is
frequently spoken of as a patron of learning
and there are several literary reminiscences
associated with this name.‡

• *Vide* Wenzel: *Journ. Pali Text Soc.* (1886), p. 1.

† S. C. Dás (l. c.) says: "Nāgārjuna is said to have been a great friend of king De-Chye (i. e. Samkara) of S. India whom he converted to Buddhism." Now De-Chye = Bdye-byed according to modern pronunciation. Dás is evidently in error in rendering De-Chye as Samkara (Wenzel).

‡ Cf.—Kāmasūtra of Vātsyāyana. वात्सी तुष्णः शास्त्रम्: शास्त्राद्वये वात्सी तुष्णी अस्तवद्वये [अस्तवा]: Referring to a "new" MS. of *Harsacharita* in his possession Hall remarks—"for Sātavāhana I there find Sātivāhana"—Intro. to "Vāsavadattā," p. 54. This by implication would suggest that the other MS. had the reading Sātivāhana.

Now "the Andhrabhrityas or Sātavāhanas ruled over the Deccan from B. C. 73 to about A. D. 218, i.e., for about 3 centuries.

"The period during which they ruled over Mahārāshtra must have been a prosperous one in the history of the country. Hence several traditions with regard to different kings have been preserved.. But that Sālivāhana or Sātavāhana was a family name must have been forgotten and different princes of the dynasty have been confounded and identified. Thus Hemachandra in his Desikosha gives Sālivāhana, Sālana, Hāla and Kuntala as the names of one individual." •

The So-to-p'o-ho of the Chinese version of the "Friendly Epistle" has been identified with one of the Sātavāhanas or Andhra kings, possibly Yajna-Sri-Sātakarni, who seems to have reigned about 172—202 A. D. There is, therefore, nothing improbable in this particular, Sātavāhana being a contemporary of Nāgārjuna. In the alchemical Tantra, "Rasaratnākara," ascribed to Nāgārjuna,

• Bhāskarīka's "Early History of the Deccan"—p. 36.

there is a dialogue between this sage and Sáliváhana (p. 6). We shall revert to this subject later on.

Numerous works have been ascribed on ✓ Nágárjuna and it is an open question if any of them be genuine. As is well known Vyāsa or more properly named Vedavyāsa has been taken to be the compiler of not only the four Vedas but also of all the Puráṇas put together. Piety and credulity go hand in hand and are seldom troubled with questions of anachronism. Plato, Democritus and Geber have been held responsible for writings which ap-

Nágárjuna as a
comprehensive name of the activity of Maháyána.

peared several centuries later.

Names, venerable and illustrious, have often been pressed into service to lend weight and dignity to productions which otherwise would not have commanded a respectful hearing. On the whole we are inclined to agree

* In Bonyin Nanjio's Catalogue of the Bud. Tripitaka there is a list of 24 works ascribed to Nágárjuna. The Subrillekha was translated into Chinese in 434 A. D. App. pt. I, p. 868.

with Kern when he says, "The figure of Nágárjuna, so prominent in the history of the rise of Maháyánism, shows a double character. It is, on the one side, the name of an influential person, the first eminent leader of a school imbued with Hinduism and the methods of Indian scholastic philosophy. On the other hand, Nágárjuna is simply a comprehensive name of the activity of Maháyánism in the first phase of its onward course."*

* In Vol I of this work (Intro. xciii), we quoted Albérûni as to the date of Nágárjuna. This cultured Arab, ordinarily a very trustworthy guide, derived his information from the Brahmins of that part of India from which every vestige of Buddhism had disappeared in the 11th century and he was evidently misled on this point as the traditions relating to Nágárjuna had at that distance of time become very vague. This will be clearly seen from what Prof. Sachau says in the preface to the Arabic edition of Albérûni.

"Its civilization was then essentially Brahminical as it had come to be in a protracted struggle with Buddhism. Albérûni does not know Indian Buddhism from personal experience though it had not yet entirely withdrawn from India and in some part was still a political power. (p. v.)

"The valley of the Kábul river and the Punjab are all that Albérûni has seen of India. (p. xiii.)

"The high schools of Hindu science and learning, Kasmir and Benares, were in Albérûni's time unapproachable for Moslems. (p. xiv.)"

From the time of Nágárjuna onwards Ma-háyánism began to be tinged more and more with Brahminical bias. A notable and decided step in this direction was taken by Asamga, a monk of Gándhára, who composed the Yogáchára-bhúmisastra, in which by assimilating the doctrines of Patañjali he paved the way for the growth of Tantras. He seems to have lived about 400 A. D. • Vasubandhu, Asamga's younger brother, was another ze-

• Cf.—Takakusu : Journ. Roy. As. Soc. Jan. 1906.

A life of Vasubandhu was translated into Chinese by Paramártha A. D. 557-569.—Bun. Nanj. Cata. p. 371. Caoma Korosi following the Tibetan Chronology says:—"I know that Arya Asamga lived in the sixth or seventh century after Jesus Christ." As. Res. XX, p. 613. This date has been accepted by Lassen (*Ind. Alt.* ii, p. 460) as also by R. Davids (*Buddhism.* p. 207). But this chronology has now become untenable. The date of Asamga and his brother Vasubandhu should be put back by about two centuries, as some of their works were translated into Chinese in the beginning of the fifth century and perhaps earlier. (Bun. Nanj. Cata. App. i p. 371). It must have taken a century or two to have their works sufficiently recognised in India before they would deserve a place in the Chinese Tripitaka.

lous adherent of this school and is said to have been a teacher in the college attached to the monastery of Nālendra—the “Oxford of Indian Buddhism.” From Tibetan sources we learn that the celebrated logician Dignāga was a disciple of Vasubandhu, a contemporary of Lha-tho-ri, king of Tibet, who lived up to 371 A. D.

Mahāyānism now began to adapt itself to

Gradual and imperceptible fusion of Mahāyānism with Sāivism.

its environments. The absorption of the Yoga ideas made the transition into the

Tantric cult easy and Northern Buddhism began to develop and expand by entering into an alliance with Sāivism, which favoured the growth of Buddhist Tantras. The origin and development of this class of literature have been the subject of a masterly exposition by Burnouf. The Mahāyānists not only set up their own deities but borrowed copiously from the pantheon of the Hindus. Thus in the Sivaite Tantras while

* S. C. Vidyābhūshana : Journ. As. Soc., Vol. i. (1905).
p. 227.

the God Siva is the fountain of all knowledge and sciences, in their Buddhist counterparts we have the celestial, metaphysical and potential Buddhas occupying the same position. The worship of the female energies (*Sakti*) which plays such an important part in the Tantras was encouraged in the person of Tārā. The Hindu Gods and Goddesses were also objects of adoration, only they were assigned a subordinate position. The question has often been asked : why did Buddhism seek alliance with Saivism in preference to the Vishnuvite cult ? The answer seems to lie in the fact that it was precisely in those parts of India where the worship of Siva, especially in its Tāntric form, had struck root that Mahāyāna asserted its sway ; † and thus the apostles and propagators of the latter made most of the former. A few centuries later when Vaishnavism gained an ascendancy in Bengal the tables seem to have been turned. A gradual and imperceptible fusion

* i. e. the Bodhimattva.

† Vide ante p. xi, (under Wema Kadipases).

took place between the rival creeds. Thus in the celebrated adoration in the opening lines of *Gitagovinda* we find Buddha freely acknowledged as an incarnation of Vishnu and extolled for his abhorrence of sacrificial rites.♦

From Fah-hian's travels we gather that in the beginning of the 5th century A. D., the Mahāyānists were gaining the upper hand, though their rivals, the Hinayānists, were still holding their own in several localities. Thus at Mathurā and Pātaliputra he found the members of both the sects living side by side and having monasteries of their own.

* विद्यार्थी ब्रह्मविदिरहम् त्रुतिकातम् चाद्यहृदयहर्षितपद्मातम् । उपर
चतुष्पदरोट् लय वसदीप चरे ॥

It is scarcely correct to assert that Buddhism was exterminated in the land of its birth by cruel persecution. Cf. Vol. i. Intro. lxvii. The Bengali poet Ramechandra Kavibharati, author of *Buddha Sataka*, though a devoted Buddha, belonged to the same class of thinkers as Jayadeva. Pandit S. P. Sastri is inclined to place him in the latter end of the 13th century.—Journal of Buddhist Text Society, Vol. I. Pt. iii. So late as 1441 A. D. MSS. of Buddhist works used to be copied from in Magadha.—Bendall's Camb. Cata. of Bud. Sans. MSS (1883), pref. iv.

From the fact, however, that the pious Chinese pilgrim repeats the *Suramgama Sūtra* for his protection, we may conclude, since he is by no means a pronounced Mahāyānist, that the predisposing causes for the origin of the Tantras were already in existence. "In this *Sūtra* is contained the most complete list of Dhāranis (invocations) found in any Chinese compilation. There are 426 distinct sections containing the names of the different Buddhas and Hindu deities worshipped at the time of the composition of the *Sūtra*. Considering that Fah-hian in the early part of the 5th century regarded this book with reverence. We may reasonably assign it to a period not later than the end of the 1st century. Now amongst the invocations we find distinct reference to Dhyāni Buddha, Vairochana, Akshobhya, Amitābha and others shewing that they were coming to be recognised and worshipped even at that early date." *

* *Intro.* to Beal's "Fah-hian." (Lxxii).

These Dhāranis may be looked upon as the precursors of the Tantras and they fully support the views that when they were composed Buddhism had turned a new leaf. The repeating of certain magic formulas along with the names of Buddha Amitābha, etc., was to secure salvation, in other words, "instead of the old doctrine [of *Karman*]—as a man soweth, so he shall reap—a new and easier way of salvation is here preached, viz., as a man prayeth, so he shall be saved. It is what is known to us as salvation by faith rather than by works. It would almost seem as if this popular and easy doctrine had secured to itself the name of Mahāyāna, as meaning the Broad Way, in opposition to the Narrow Way, the Hinayāna.*

The new class of literature which now arose in order to meet the demands of the Mahāyānist revival is collectively known as

* Max Müller, Buddhist Mahāyāna Sūtras. Intro. to larger *Saṅkhārati-Vyūha*, ix. S. B. E. Series, Vol. xliz.

the Vaipulya Sútras or the Sútras of the developed school, of which the Dháranis are an integral part. It found expression in such works as the "Saddharma-pundaríka," "Lalitavistara," "Tathágataguhyaka," "Prajñápáramitá," etc., —all of which soon acquired almost canonical sanctity in the estimation of the N. Buddhists. Burnouf has tried hard to differentiate between the simple Sútras as represented by the literature of the primitive orthodox Buddhism and the expanded Sútras of which the distinguishing mark is the occurrence of Bodhisattvas. This drawing of hard and fast

• "La présence des Bodhisattvas ou leur absence intéressent donc le fonds même des livres où on la remarque, et il est bien évident que ce seul point trace une ligne de démarcation profonde entre les Sútras ordinaires et les Sútras développés. —Burnouf, Intro. p. 112; *ibid.* p. 120. Ed. 1844. Voir Max Müller's remarks at the end of the Smaller Saṅkhitati. Vyūha, p. 102, S. B. E. Series, Vol. xlvi.

Cf. also "Some Vaipulyas are, materially, much like the old Sútras, whole passages e. g. of Lalita-Vistara recur almost word for word in the Páli Scriptores." Kern (Ind. Bud. p. 5). This eminent Buddhist scholar also very appositely re-

lines has been found to be well-nigh untenable.♦

By the second century A. D. we find the leading beliefs and ideas as crystallised in the Mahāyāna literature fully in vogue. Thus we

marks elsewhere : "The results arrived at by Burnouf may be right so far as Mahāvaipulya Sūtra as a whole is concerned, they cannot be applied to all the component parts of such a work. Not to go further than the Saddh. and the L. Vistara, it can hardly be questioned that these works contain parts of very different dates, and from various sources."—Kern, Intro. to Saddh., pp. x-xi. Passages in L. V. are literally identical with those in Mahāvagga. Again :—"These few examples I have chosen will suffice to prove that the material of a Mahāvaipulya Sūtra is partly as old as that of any other sacred book of the Buddhists."—*Ibid.*, xiv.

• The truth seems to be that "the historical relation between the Hinayāna and the Mahāyāna schools of Buddhism is to me as great a puzzle as ever."—Max Müller, Intro. to L. Sakh. Vyūha, ix. Even the very distinction between the N. and the S. Buddhism has been taken strong exception to by R. Davids, who says :—"There is not now and never has been, any unity either of opinion or of language in what is called northern, or in what is called southern Buddhism. There is a distinct disadvantage in continually suggesting a unity which has no existence in fact. In a word the current division of Buddhist literature into northern and southern is entirely unscientific, and misleading."—Bad. India, p. 173.

come across in the "Buddhacharita" of Asvaghosha, who is admitted on all hands to be a contemporary of Kanishka, such a passage as this : "this, Sirs, is the Mahāyāna, the instrument of the law of the perfect Buddha, which is the establisher of the welfare of all beings, set forth by all the Buddhas."• The "Lotus of good Law" was translated into Chinese at the close of the second century A. D. †

Side by side with the growth of the scriptures another class of literature was called ^{Buddhistic Tan-} into being by the exigencies _{tras.} of the times—we mean the Tantras, the necessity for which has been hinted at in the first volume. ‡ However esoteric may be the doctrines sought to be conveyed through the medium of these productions, it would be idle to deny that there

• Cowell's trans. p. 184. S. B. E. Series, Vol. xlvi.

† Edkin's "Chinese Buddhism," p. 89. There were several versions of this sacred book.—Vide Kern's Intro. p. xxiii (S. B. E. Series).

‡ Vol. i. Intro. lxx.

is much in them which is calculated to pander to the baser instincts of frail humanity. At what particular time these Tantras appeared on the scene is yet a matter of conjecture, but the views of Wilson which held the ground for more than 30 years have now been found to be erroneous. Evidence is now forthcoming from quite an unexpected source, which goes to prove that Buddhist Tantras existed as early as the fifth or sixth century A. D., if not earlier. • If Buddhist Tantras, again, pre-suppose the existence of Hindu Tantras, one need not be considered as rash in assigning an earlier age to the latter. †

* *Vide* the palm-leaf MSS. discovered in the monastery of Horinji in Japan and carried from Central India. One of these is in the handwriting of a famous Chinese priest, named Kanshin, who came to Japan in A. D. 753. The MS. contains besides a Dhāraṇī, five Tantras. "Bud. Texts from Japan," ed. by Max Müller. Vol. I, pt. i, Intro, pp. 6-8. It is fair to conclude that these Tantras existed in the land of their birth at least two centuries earlier.

† Waddell says:—"No one has yet realised the vast extent to which Mahāyāna and Tāntric Buddhist remains cover India; nor sufficiently realised the leading part played by the Mahāyāna in Indian Buddhism during its popular period," Journal of the Roy. As. Soc. (1894).

The Tantras found a congenial home in China. Amoghavagra, a Sramana of northern India and a Brahmin by caste resided in the Celestial Empire for several years between 746 and 771 A. D., and under his influence the Tántric doctrines dealing with talismanic forms and professions of supernatural power first gained currency there.* Hence long before his time Tantras must have been popular in India. From the eighth to the eleventh century A. D. we are in possession of authentic records as regards the prevalence of Tantras in Northern

Tantras imported
into Tibet.

India ; as it was about this period that several of these

were gradually imported into Tibet by Indian Pandits, but they must have been composed much earlier. †

* Bun. Nanjio's Cata. App. ii, p. 445. Amoghavagra translated 77 works including Ushnisha-chakravarti-tantra, Garudagarbha-tantra and Vagnakumgra-tantra.

Cf.—Also 'The existence of the Tantra Sástras may thus apparently be traced at least as far back as the 6th century A. D.'—*Vide* "Annual Report," As. Soc. Beng. 1908.

† In the first half of the eighth century two eminent

Atissa gave a fresh impetus to Tantrism in the land of snow. From the analysis of Mdo by Csoma we also come to know in detail the names with the dates of the Indian scholars who with the aid of the local interpreters (*locharas*) rendered into Tibetan the various Sanskrit Tantras. The faithful accuracy with which these translations were made and their fidelity to the original enable us often to reproduce the Sanskrit Texts and thus we are in possession of valuable histori-

Pandits of Bengal visited Tibet at the invitation of its king and formally introduced there Buddhism; these Pandits were Sānti Rakshita, high priest of the monastery of Nālandā and his co-adjutor Padma Sambhava, a native of Udyana, who took charge of the Tantric part of the Buddhist liturgy. They were followed by the sage Dipamkara-Sri-jéana (Atissa), b. A. D. 980, d. 1053. He acquired proficiency in the three pitakas of the four classes of the Hinayána Srávakas, in the Vaisháhika philosophy, in the three pitakas of the Maháyána doctrine, the metaphysics of the MÁdhyānika and the Yogachárya schools and the four classes of the Tantras. At the request of king Naya Pála he accepted the post of high priest of the monastery of Vikramashila.—Vide S. C. Das,—Journal of the Buddhist Text Soc. Pt. i.

cal data. Some of these Tantras deal with alchemy and their contents reveal to us the knowledge of chemical processes in India from about the 6th to the 8th century A. D.†

Fortunately we are not dependent upon the Tibetan Tantras alone for gaining an insight into this dark recess in *Rasaratnākara*, the history of Hindu intellectual activity. In the course of our search

* Speaking of the Tibetan translation of Asvaghosha's *Buddha-Charita*, Cowell remarks: "The Tibetan version appears to be much closer to the original Sanskrit than the Chinese; in fact from its verbal accuracy we can often reproduce the exact words of the original, since Sanskrit words are always represented by the same Tibetan equivalents, as for instance the prepositions prefixed to verbal roots."—I. c. Intro. p. x. Waddel is equally impressed with the "profoundly accurate and scholarly nature of the Lámaist translations of Sanskrit Buddhist books;" and he again observes: "It is clear that the Tántric and Maháyána features of Lámaism were imported *en bloc* from Indian Buddhism."—Journal of the Royal As. Soc. for 1894, p. 15.

† Analysis of the contents of the *Bido* (*Sūtra*) by Chomade Korosi—Asiatic Researches, XX (1838), p. 583. "A work on preparing quicksilver, the most powerful for subduing every sickness and for improving the vigor of the body."—"A work on turning base metals into gold." We are thus reminded of the contents of the *Rasárnava* and the *Rasaratnākara*. *Vide* p. 2.

for MSS. of alchemical Tantras we have come upon a precious find, in the shape of a Buddhist Tantra, with Nāgārjuna as its reputed author. Of alchemical Tantras we have had enough and to spare ; but there is great difficulty in assigning dates to them, as they one and all pretend to emanate from the mouth of the God Siva himself. We are only left to internal evidences—evidences based upon the gradual evolution of chemical processes, which we have not been slow to take advantage of. The MS. in question is a mere fragment, but it is calculated to

Its historical importance. evoke all the zeal and enthusiasm of a Palaeontologist—or of an Owen or a Marsh—in his efforts to restore an animal and assign to it its proper place in the economy of the laws of evolution, when he luckily chances upon a fossil impression of its tooth or claws. From this point of view Rasaratnākara, for such is the name of our MS., is of uncommon interest. It is a Tantra of the Mahāyānist school and as such its invocations are

addressed to all the Buddhas ;* and in one place there is a pointed reference to Prajñā-páramitá †(perfection of wisdom) appearing before Nágárjuna in a dream and revealing to him chemical knowledge.‡

A noteworthy feature of this work is that some chemical processes are discussed in the form of a dialogue between Sáliváhana and Nágárjuna, and Ratnaghosha and Mánudavya.§ These last two names are held equally in veneration with Nágárjuna and grateful acknowledgments to their services occur in some later chemical treatises.¶ The bringing together of these four *dramatis personae*.

* शिवम् सम्प्रवाप्तम्। Cf. The opening invocation in the *Sukhávatí Vyúha*: शिवं यतः शीर्षस्तुहसीविद्वेषः । also यतः प्रदेहतुह चार्यकावकावाम् नमो शोषितावाम् in A'rya Mañjuśrīmála Tantra.—Vide As. Res. xx, p. 512.

† Cf.—The invocation in *Vagrachchhediká* नमो अवक्षा चार्यकावापारकितावे.

‡ Vide Sans. Texts, p. 10, also Trans., p. 5.

§ Vide Sans. Texts, pp. 12-14, also Trans., pp. 6-8.

¶ Cf. Vol. i, p. 77.

especially of the first two has a significance of its own. We have already seen that references to Nāgārjuna and his contemporary king Śalivāhana are only to be met with in ancient classical literature (*vide ante* xxii). It seems probable that Rasaratnākara was written at a time when the memory of these personages was still fragrant. Judging from internal evidences also we come to the conclusion that it is one of the earliest works extant on the subject. In our attempt at throwing light on the text of Rasārṇava, we had to quote several parallel passages from it, and from a careful perusal of both we are

Also a typical production of the Mahāyānist period of intellectual activity.

of opinion that the latter is the inspirer rather than the borrower. Rasaratnākara, in short, seems to us to be a typical production representing the Mahāyānist period of intellectual activity and we may not be wide of the mark if we put down 7th or 8th century A. D. as its latest date.

* *Vide Vol. I, Sans. Texts, pp. 7, 12, 13 and 18.*

From the 5th to the 11th century A. D. the colleges in connection with the monasteries of Pātaliputra, Nālandā, Vikramasila, Udaṇḍ-pura, etc., were the great seats of learning as the temples attached to the pyramids in ancient Egypt ; and alchemy was included in the curricula of studies.♦

The existence of a vast ancient Tāntric literature with alchemy as a component part has now been placed beyond doubt, thanks to the searching examination of the Mahārājā's collection of valuable MSS. of Nepal by the eminent scholars Bendall, H. P. Sastri and S. Lévi. Of surpassing interest is the discovery of a Tantra belonging to the extinct school Kubjikāmata, written in Gupta character and copied about the sixth century A. D. This

[♦] Cf. "By the side of the tower of king Asoka is built a Samghāṭa, belonging to the great vehicle, very imposing and elegant. There is also a temple belonging to the little vehicle.....In the college attached to the temple one may see eminent Sramanas from every quarter of the globe."—Beal's "Fab-hian," ed. 1869, p. 105.

school, though itself very ancient, presupposes the existence of other schools and we have distinct mention of the Mahāyāna.* We now learn that the gradual fusion and amalgamation of Sivaite and Buddhist Tantras had begun even anterior to the sixth century. The Kubjikā-tantra was evidently composed outside India proper, probably in Nepal. The Goddess Pārvati encourages her consort to proceed to the continent for the spread of the tenets propounded by it. † In one place we come across a passage ‡ in which Siva himself speaks of pārada (mercury) as his generative prin-

* Catalogue of Palm-leaf and selected paper MSS. belonging to the Durbar Library, Nepal, by H. P. Sastri (1905). Ixviii, n. seq.

इविदि देवदानी तु पिहकामस्तीतरे ।
मत्तमे तु महायानं विवरणा प्रवीकृते ॥
† यस्य ते मारते वर्णेऽविवाराव सर्वतः ।
‡ अशोष्यः पारदो यह पवित्रः कुटिनं भव्यः ॥
महोर्येष अस्त्राले तामायो गुलके यहि ।
तिष्ठनि उच्चृताः कामः अस्ता एव विवारणाम् ॥

For the passages cited here we are indebted to the industry and courtesy of Pandit H. P. Sastri, who has wended his way through the bulky MS.

inciple and eulogises its efficacy when it has been killed six times.* We also find allusions to the transmutation of copper into gold with the aid of mercury. In short, we have ample references to alchemical processes described in the very technical terms in which Rasárnava, Rasaratnákara and other typical works of the Tántric period abound. †

It is now only necessary to wind up this chapter with an extract from the work of an eminent Budhologist with this reservation that the growing influence of Tantrism began as we have seen long before the 8th century.

"The decline of Buddhism in India from the 8th century downwards nearly coincides with the

* Even at the present day mercury, which has been killed six times in succession, each time with an equal weight of sulphur वृक्षसुखाम्बारित, is reputed to be one of the most potent of remedies.

† e.g. पवित्र विद्विती वेदः विद्य वज्रती न विद्वते ।

रवदिव यथा ताप्तं न मूषकाम्बतो व्रद्वित् ॥

For the meaning of the word वेद (Vedha) see this Vol. p. 18, footnote, also Vol. i, p. 120.

growing influence of Tantrism and sorcery, which stand to each other in the relation of theory to practice. The development of Tantrism is a feature that Buddhism and Hinduism in their later phases have in common. The object of Hindu Tantrism is the acquisition of wealth, mundane enjoyments, rewards for moral actions, deliverance, by worshipping Durga, the Sakti of Siva—Prajña in the terminology of the Mahāyāna—through means of spells, muttered prayers, Samādhi, offerings, etc. Similarly the Buddhist Tantras purpose to teach the adepts how by a supernatural way to acquire desired objects, either of a material nature, as the elixir of longevity, invulnerability, invisibility, alchemy ; or of a more spiritual character as the power of evoking a Buddha or a Bodhisattva to solve a doubt, or the power of achieving in this life the union with some divinity. There is an unmistakable affinity between Tantrism on one side, and the system of Yoga and Karmakāṇḍa on the other. Tantrism is, so to say, a popularised and, at the same time, degraded form of Yoga, because the objects are commonly of a coarser character, and the practices partly more childish partly more revolting.

“Tāraṇātha informs us that Tantrism existed and was transmitted in an occult manner in the period

between Asaṅga and Dharmakīrti, but that after Dharmakīrti's times the Anuttarayoga became more and more general and influential. Substantially his statement is certainly right. He adds that during the reign of the Pāla dynasty, there were many masters of magic, Mantra-Vajrāchāryas, who, being possessed of various Siddhis, performed the most prodigious feats.

"The kings of the Pāla dynasty, whose sway over Gauda and the adjacent regions lasted from about A. D. 800 to 1050, are known both from the annals and their inscriptions as protectors of the Faith. It was during that period that the monastery of Vikramasīla was a renowned centre of Tantrist learning.

"The Sena kings, who followed the Pālas in the dominion over Eastern India, though belonging to a Hindu persuasion, were not hostile to the Faith. Still Buddhism declined during their reign and more so after the invasion of the country by the Muhammedans in A. D. 1200. The monasteries of Uḍḍandapura and Vikramasīla were destroyed; the monks were killed or fled to other countries. The learned Sākyasīti went to Orissa, and afterwards to Tibet; Ratnarakṣita to Nepāl; Budhāmitra and others sought a refuge in S. India, whilst Saṅgama-Srijñāna with several of his followers betook themselves to Burma, Camboja, etc.

And thus the Law of Buddha became extinct in Magadha.

"Many emigrants from Magadha rejoined their brethren in the South and founded colleges on a modest scale in Vijayanagara, Kalinga, and Koṅkan. The comparatively satisfactory condition of Buddhism in Dekkan about that time is attested by the rich donations to the monastery at Danibal."^{*}

It will be noted that the monks of the monasteries of Udaṇḍapura and Vikramasila on their dispersion carried with them their learning and arts in the same manner of the

Spread of al- Byzantine Greeks on their
chemy. expulsion from Constantinople bore with them their intellectual treasures to the Italian cities. In the kingdom of the Deccan and in Tibet the Buddhist refugees found hospitable asylums, † just as the Greek Philosophers did in the Florentine Republic under the Medicii.

* Kern—Manual of Ind. Bud., pp. 133—134.

† Cf.—"The Deccan, which from the eleventh century was the refuge and centre of literary activity generally. In Hindustan it had been substantially arrested by the inroads and ravages of the Muhammadans,—Weber. Hist. Ind. lit. p. 283.

Some eminent orientalists, whose opinions naturally carry weight, have hitherto taken for granted that the knowledge of chemistry such as we find reflected in the Tantras quoted by Málikhava in *Rasesvaradarsana* was derived by intercourse with the Arabs.[†]

• Vol. i, Intro. lxxviii, et seq.

† E.g. Barth : "In regard to alchemy, anyhow in which the Sittars are zealous adepts, they were disciples of the Arabians, although other Sivaites had preceded them in the pursuit of the philosopher's stone. Already, in his exposition of the different doctrines of the Saivas, Séyana thought he ought to dedicate a special chapter to the *Rosesvara-darsana* or "system of mercury," a strange amalgamation of Vedantism and alchemy. The object contemplated in this system is the transmutation of the body into an incorruptible substance by means of *rasapána*, i.e., the absorption into it of elixirs compounded principally of mercury and mica, that is to say, of the very essential qualities of Siva and Gauri, with whom the subject of the operation is thus at length identified. This species of transubstantiation constitutes the *jivanmukti*, or state of deliverance commencing with this present life, the sole and indispensable condition of salvation. It is clear that the devotional formulae of the Vedánta are here only a sort of jargon, under which there lies hid a radically impious doctrine; and it is not less clear that in this doctrine, which had from the fourteenth century produced a rather considerable literature, there is an infusion of Mohammedan ideas..... The Arabs of the Khalifat had arrived on these shores in the character of travellers or merchants, and had established commercial relations and intercourse with these parts long before the Afghans, Turks, or Mongols, their coreligionists, came as conquerors."—"Religions of India," ed. 1891, pp. 210-211.

The attentive reader who has followed us
 In Tibet and the all along could not have failed
 Deccan. to notice that it was in the
 Universities of Nálená, Udaṇḍapura and
 Vikramasila, in Central India and Magadha,
 precisely the regions which were cut off from
 communication with the external world, that
 Tantric mysticism with alchemy as an integral
 part was cultivated and from thence spread
 to Bhot (Tibet) and the regions lying to
 the south-east of it,* and South India.†

* See under colophons to *Rasahridaya* and *Rasamra* respectively.

† The last rallying point of Hindu learning and sciences was the kingdom of Vijayanagara, which was in the heyday of its glory under Bakka I (A. D. 1354-1371) with Mādhaba as his prime Minister. Wilson says:—"The history of Vijayanagara is a subject of considerable interest in the annals of India, as the last barrier that was opposed to Muhammadan invasions, and that preserved the southern part of the Peninsula from foreign rule until a very modern period."—*As. Rev.*, Vol. xx (1890), p. 1. See also Sewell's "A Forgotten Empire"—(Vijayanagara).

CHAPTER II.

Having thus far prepared the ground for believing that alchemy along with other cognate branches of learning was the outcome of Indian intellectual activity, we shall now proceed to follow it up with its further deve-

Further cultivation of alchemy. lopment. At the outset it is, however, necessary to remember that on the decline of Buddhism the vigorous impetus which its followers gave to literature and science was not lost to India. Nay, during and after the revival of Brahminism under the Gupta dynasty and its successors we have some mighty intellectual giants whose productions will continue to shed lustre as long as the Hindu nation exists. Kālidāsa and Bhavabhūti, Brahma Gupta and Aryabhatta, Samkara and Rāmānuja are names which may be regarded as the heritage not of India alone but of the entire civilized world. At the time of the Brahminic revival Buddhist works of acknowledged merit far from

being cast aside were held in veneration. Amarasimha in his Lexicon and Vāgbhata in his *Ashlāmgahrīdaya* • as also the pseudo-Vāgbhata • commence with an invocation to Buddha, which has never shocked the tolerant spirit of the Hindu. Charaka and Susruta also bear distinct impress of Buddhist retouching. The Buddhist *Trantras* became likewise a part and parcel of Hindu religio-philosophical literature,† the subject-matter

Buddhist albo-
mical Tantras ab-
sorbed into Hindu
Tantra.

of the former was incorporated into the latter, the names of Tārā, Prajñāpāramitā and Buddha being simply changed into those of Pārvati and Siva. In *Rasaratnakara* itself we have distinct indications that it is an admixture of both.

• Vol. i, p. 76.

† Speaking of a typical Buddhist production belonging to this category Burnouf observes : "Ce morceau est exclusivement spéculatif, et il nous offre une nouvelle preuve de l'alliance intime que le système des Tantras a contracté avec la philosophie buddhique la plus élerte" (L. c. p. 543 ed. 1844).

It should thus be understood that the works under review in this chapter are based upon their Buddhist counterparts ; in short, there is no disposition to ignore the debt of obligation the authors are under to Nāgārjuna, Ratnaghosha, Māndavya and others.

In the introduction to the first volume we stated : "It is to be regretted that the several works quoted by Mādhaba [on the science of mercury] Rasārnava alone seems to have survived to our days" (l. c. lxxxiii). Since then we have been fortunate enough to procure as many as three transcripts of MSS. of Rasahridaya by Govindabhatta from different quarters. As Mādhaba speaks of this author in terms of the deepest reverence and regards him as "ancient," we think we should not err on the wrong side if we place the author some three

* Cf. Vol. i, Intro. lxxx.

सन्दर्भात् श्रीविष्णवद्वयादाचार्यदम्बुद्धामिश्रराज्ञाराज्ञविभिः
शास्त्रीराज्ञार्णविभिः ।

The qualifying epithet अवत् is only applied to venerable Brahmins of old.

centuries before his time. If our surmise be correct, he should have lived about eleventh century A. D. The only personal allusion which the author has condescended to offer for the edification of posterity is that he wrote his book at the request of the king of the Kirataland, i.e., the region adjoining modern Bhotan. Portions of this remarkable treatise after a careful collation of the MSS. have been reproduced in the proper place. The worm-eaten fragmentary MS. produced from Benares is 386 years old. Internal evidence equally goes to establish the antiquity of this work. The author was evidently a Buddhist as we learn from the colophon to the Benares MS. (*vide* trans. p. 12). It is, however, not to be found either in the India office or the Nepal MS. This important omission is easily accounted for. It is the reluctance of the latter day Hindus to acknowledge their obligations to a Buddhist author.

Rasarnava which has been noticed at length in the first volume and to which was assigned the 12th century A. D., as also Rasaratna-

samuchchaya (13th to 14th century), need not further arrest our attention.

The presentation of the various treatises of the Tantric and iatrocchemical periods under discussion in their exact chronological sequence is not an easy task ; in the absence of more definite information, we are afraid, we shall now and then have to hazard a conjecture.

The introductory lines of Books viii and ix of *Rasaratnasmuchchaya*, in which Somadeva is mentioned as the author of the descriptive part, led us to suspect that they are merely reproductions from "a standard work on the subject by Somadeva, no longer extant."• Our surmise has proved to be partially correct. We have at last been able to recover the supposed lost work. A transcript of a MS. of *Rasendrachūḍāmani* by Somadeva, preserved in the Library of the Deccan College, Poona, reveals to us the fact that

• Vol. I, p. 118.

practically all the important portions of this book have been woven into the text of Rasaratnasainuchchaya ; and this gives us an additional opportunity of collating many doubtful passages in both. But the present work itself does not lay claim to originality. It makes a candid admission that it culls all its materials from pre-existing chemical treatises.♦ It further puts forward the alchemist Nandi as the inventor of the process of sublimation and of the Koshthi apparatus (Vol. i, pp. 69 and 89).† Nāgārjuna, Dandi, Sambhu and the sage Brahmajyoti are also spoken of as sources of his inspiration. We get very little inkling into the personal history of Somadeva, except that he was the ruler of a city named Karavālahhairava. The fact that R. R. S. lays Rasendrachudamani so amply under contribution would suggest that the latter had become somewhat rare

* यह दक्षादि वस्तु के रसताकालीनेकाज़ ।
दक्षादीव उमाहिन सोमदीवेन दात्र्यतम् ॥

† यह पातनदर्शक हि नन्दिना परिकौर्तितम् ।
बीहिकायनमेतद्वि नन्दिना परिकौर्तितम् ॥

or that its contents had been well-nigh forgotten when the former was compiled. Its date may therefore be put down between the 12th and 13th centuries A. D.

Another important work of this period is *Rasaprakasa-sudhakara* by Yasodhara. The author of R. R. S. in the opening lines mentions the names of 27 alchemists to whom he is beholden, among which occurs that of Yasodhana. We have little doubt that the

Rasaprakasa-
sudhakara. correct reading is Yasodhara.

We now find that there is very little original matter in R. R. S., it being made up of citations from *Rasarnava* and the works of Somadeva and Yasodhara. We should not, however, be understood to retract the high encomiums we thought fit to bestow upon R. R. S. for "its methodical and scientific arrangements of the subject-matter, which would do credit to any modern work."• Its author has never laid claims to originality, but, on the contrary, has freely acknowledged the sources he drew upon. The student of

Hindu chemistry, however, like a weary but devout pilgrim, must wind his way through intricate and thorny paths and feel ineffable joy at being able to approach the original fountain undefiled. It now transpires that the credit for the accurate observations on the metallurgy of zinc (Vol. i., pp. 88 & 156) really belongs to Yasodhara. While the author of B. R. S. always scrupulously admits that his work is a mere compilation, Yasodhara, on the other hand, is anxious to let the world know that the processes he describes have been verified by experiments performed with his own hands. Among the authorities he cites are Nágárjuna, Deviśāstra (probably Rasārṇava), Nandi, Somadeva, Svachchhanda-bhairava and Manthanabhairava. As Yasodhara quotes Somadeva, he must have been posterior to the latter by at least a hundred

* Cf. यहांन इतं दद्यत् वारवं न गुरुत् वा ।

यहांन भवतीविम इतं दद्यत् चुमित् हि ॥

चातुष्प्रकृतीयोऽही यहांन इतो वा ।

हटाष्प्रकृतीयोऽही विती वाच चंद्राः ॥

years and he should therefore be placed in the 18th century A. D. •

Rasakalpa likewise seems to belong to this period. It is in the shape of a Tantra, but curiously enough it is not much troubled with consistency. In the opening salutation Siva, "the king of mercurial lore" and his consort Chandikā are reverentially bowed to—a procedure scarcely reconcilable with the position of a revealed document. The colophon at the end of each Chapter (भाग) claims the work to be a part and parcel of Rudrayāmala Tantra; at the same time due acknowledgment is made to the contributions of Govinda, the author of Rasa-hridaya, Svachchhandabhairava and other adepts.† Towards the end the author says : "The processes described have all been verified by me and not borrowed at second-hand from my teachers." Needless to add here that the God Siva would not have

* We are using a copy of the MS. preserved in the Ranbir Library, Kāshī. The readings are on the whole accurate.

† E.g. रसायनविदीर्ततः।

been at pains in justifying the necessity of his production with such a timorous apology. From internal evidence it is abundantly clear that it could not have been composed earlier than the 18th century A.D.

As the author has confined himself solely to a description of the metals, minerals and the processes of "killing" them with the agency of various apparatus and has not gone into the treatment of diseases with the aid of mineral preparations, he has been able to condense much important information within the narrow compass of a few short chapters.

Rasarājālakshmi also deserves some prominence here not because of its intrinsic worth but because of the references to previous Tantras and alchemists, amongst which are *Rasār-nava*, *Kākachandīvara*, *Nāgārjuna*, *Vyādi*, *Svachchhanda*, *Dāmodara*, *Vāsudeva* and *Bhagabat Govinda*. We have also categorical mention of the purely Ayurvedic works such

as Charaka, Susruta, Hārita and Vāgbhata, to which our author is equally indebted. From the colophon to the MS. procured from Benares we learn that the author Vishnudeva was Court Physician to king Bukka.† If this statement be accepted—and *prima facie* there is no reason to question it—this treatise must have been compiled in the latter part of the 14th century. Internal evidence equally supports this date.

* *Vide Sanskrit Texts*, pp. 80-81.

† *Vide ante*, footnote, xlvi.

CHAPTER III.

c. 1350 A. D.

We now proceed to examine the contents of another series of works belonging also to the Iatro-Chemical period ; the one characteristic feature of which is that opium is recognised as an official drug in the *materia medica* portion. These may be taken to date from the middle of the 14th century A. D.

Rasanakshatramáliká by Mathanásimha, physician to the king of Malwa, should find a place in this chapter. For particulars as to the contents the reader may consult p. 22. The date given by the copyist of the MS. is Samvat 1557 i.e. 1500 A. D. The work itself is therefore older.

Rasaratnákara by Siddha Nityanátha, son of Párvati, comes under this category.* The author gives the sources of his information and explains the object of his compilation.

* Two editions of this somewhat voluminous work have been published—one by Ganessa Chandra Ghose (Calcutta),

tion in the following words : "Whatever has been revealed by Siva in Rasāraṇava under the preparations of mercury ; the Dīpikā of Rasamangala on mercury ; all that has been said by Nāgārjuna for the benefit of people afflicted with diseases, as also by Siddha Charpati, by Vāgbhata and Su-
ṣṭuta,—all these and many other treatises on mercury and minerals being consulted, I have, after rejecting the drugs and medicaments which have become rare and difficult to procure, put together [in my work] the essential features thereof. • • • • All that I have learned from my teachers and have been in a position to subject to practical tests has been incorporated into my work for the benefit of mankind." In addition to the authorities cited above Nityanātha quotes from Chakrapāni and Rasendrachūḍāmani (*ante* liv).

the other at the "Venkateswara Press" (Bombay). We have compared the readings of these two editions with the MS. in the Library of the Sanskrit College, Calcutta. They agree fairly well.

Rasendrachintāmani will next claim our attention. We have before

Rasendrachintā-
mani.

us the printed copy, edited by Umesa Chandra Sena Gupta,

late librarian, Sanskrit College, Calcutta, in which the text has been adopted, as the editor informs us in the preface, after collation of 3 or 4 MSS. We have carefully gone over this edition and compared its readings with those of a MS. procured from Benares and another from the Runbir Library, Kāsmīr. All these agree in the main, but there happen to be certain omissions and additions, which form an interesting chapter in the history of interpolations in the literature of this description. To begin with : there is a dispute over its very authorship. Some MSS. ascribe it to Dhundhukanātha, disciple of Kalanātha, others to Rāmachandra. After the customary salutation there occur two couplets in the Calcutta edition, which are not met with in the Benares and Kāsmīr exemplars. In these the author is made to justify his *raison d'être* for undertaking his task in these words :

"I shall give publicity only to such processes as I have been able to verify by my own experiments." Such protestations have already been noticed more than once. In another place we have : "Those mercurial operations alone have found a place in my book, which I have been able to put to tests. Those who teach without being able to perform experiments labour in vain." This last couplet is quite out of place as it hangs like a tail to a long extract from *Rasarnava* and is in fact conspicuous by its absence in the Benares and Kāsmīr MSS.[†] For the second time we find calomel designated as *Rasakarpūra* (lit. camphor of mercury; *vide* vol. i, p. 250). This preparation no doubt occurs in the older

* Such pretensions put forth on behalf of the author, especially in the first person singular, lead one to suspect that they are later interpolations. In the Arabian alchemy Geber is often made to declare to the same effect: e.g. "J'ai expérimenté moi-même tout ce que je rapporte."—Berthelot, "La Chimie au moyen A'ge," t. I, p. 338. The well known egoistic couplet in *Susruta*, Ch. i, एष हि व्यक्तिराहिष्यः is generally regarded as an interpolation.

† The extract commences with एष आदा संवेदनाम्.

works, e. g. *Rasarnava*; but it is described there as the white "ash" of mercury (*svetabhasma*). The recipé for calomel as given in the Calcutta edition, however, is quite different from that in the Benares and Kāshī MSS. and it is altogether wanting in one of the MSS. in the Calcutta Sanskrit College Library. We are therefore not without suspicion that it has been foisted into the original composition. The author refers to *Rasarnava*, *Nāgārjuna*, *Govinda*, *Nityanātha*, *Siddha Lakshmivara*, *Trivikramabhatta* and *Chakrapāni*. There is a lengthy colophon but no direct information can be derived from it as to the age of the author.

Rasasāra : It is a comprehensive but purely chemical work dealing with 18 operations on mercury; various chemical processes are incidentally described, a good many of which, however, overlap each other. There does not seem to be any justification for coining a multiplicity of technical jargons to connote each of these. But prolixity was never regarded in the light of a vice by the

alchemical writers of the middle ages either in India or in Europe. The contents of *Rasasara* often remind us of a poem on alchemy by George Ripley, canon of Bridlington in Yorkshire (b. about 1460), of which Rodwell says :—

"But we cannot point to a new fact which he elucidated. He divided all chemical operations into twelve processes—calcination, dissolution, separation, conjunction, putrefaction, congelation, cibation, sublimation, fermentation, exaltation, multiplication and projection. Several MS. copies of his poem exist in the British Museum, bound up with copies of the works of Roger Bacon and earlier writers. Here is a specimen of his rugged rhymes :—

The first chapter shall be of natural *Calcination* ;
 The second of *Dyssolution*, secret and phylosophycall ;
 The third of our elementall *Separation* ;
 The fourth of *Conjunction matrimoniall* ;
 The syfth of *Putrefaction* then followe shall :
 Of *Congelation Albyficative* shall be the Sixt,
 Then of *Cybation*, the seventh shall follow
 next."•

• *Vide "Birth of Chemistry".*

The author, Govindacharya, as a devout Hindu, begins with his adoration of Siva and Vishnu and tells us at the outset that his treatise is a compilation and epitome based upon standard works on the subject and the contributions of the adepts. We have every reason to be thankful to him for the many hints he throws on the sources of his information. Of surpassing interest is his declaration that for a knowledge of certain processes he is indebted to the Buddhists of Tibet.● This must be taken to mean that the cultivation of alchemy had become neglected and almost forgotten in India proper and the earnest searchers for this lore had to repair during the time of our author to Tibet.¹ Confirmatory evidence to this effect is equally

● एवं वीरा विज्ञानम् भाटटीष्वनिष्ठितः ।

Towards the close of his work the author again acknowledges his obligation to the Buddhists.

बौद्धमते तथा चाला रुचारः इति स्मा ।

We have in our possession five transcripts of the MSS. of Ramaśrī procured from the Libraries of Kāshī, Tanjore, Ulwar, Madras and the Temple of the Goddess Kālī, at Ramnā, near Dacca, Bengal.

furnished in the colophon to *Rasahridaya* (trans. p. 12). During the decadence of Buddhism and the corresponding ascendancy of Brahminism in Bengal, say about the 11th to 13th centuries A.D., this branch of science also found a safe retreat in the land of the Kirātas as we have already seen. Burnell, under the influence of his preconceived notion, namely that Indian alchemy owed its origin to the Arabs, very naively remarks : "By *Baudhas* he (the author) probably means the Muhammedans (*q.v.* the vernacular Malayalam use of the word), though studies of this nature were much pursued by the later Buddhists."*

Some idea of the date of *Rasasāra* may be formed from the fact that there is mention of opium in it. But our author was evidently quite in the dark as to its origin ; for, says he : "There are 4 different kinds of poisonous

* Catalogue of the Tanjore Palace MSS. pt. 1, p. 70. Burnell draws his conclusions from the reference to Buddhists in the colophon ; but we have quoted above another passage in which distinct mention is made of the Buddhists of Tibet.

sea-fish, and it is from their foam that 4 different kinds of opium are derived, namely, white, red, black and yellow ; while others maintain that it is derived from the foam of the snake and it is very properly used for chemical operation,"—*e. g.*,—killing and fixation of mercury. From the context it is, however, doubtful if the narcotic drug is really alluded to here. But independently of the use of this term we may safely place this work in the 18th century A. D.

* समुद्र चेत आवस्ये विषमस्थावर्तुर्बिषः ।
तेष्वः परं समुद्रवृष्टिर्विषिणी विष कुचुर्विषः ।
केविहरुणि सपांशो चेत आहिष्करणः ।
यथा—आरवं चेतव्ये च रत्नव्ये च आरवं ।
सारवं दीतव्ये च लक्ष्मव्ये च मारवं ।
विषविद्वत्तम् फेन युवत्ते रक्षकर्षितः ।

The Sanskrit word for opium, "aphibena," lit., foam of the snake, is of modern date. It is generally held that this word has been Sanskritised from the Arabic "aphiyūn."

These identical distichs also occur in the commentary on *Sringadhara* by *A'dhamalla* with the additional line, आरवः (आरवः) चीरविशेषः, namely, it is the milky juice of poppy; proving that during the time of the latter its real origin was known, at the same time its supposed origin was not disbelieved.

Sāṅgadhara-samgraha—a compilation by Sāṅgadhara : its peculiarity is that it is based upon the A'yurvedas (Charaka, etc.) on the one hand and the Tantric chemical treatises on the other. In the chapter on the purification and incineration of metals, 7 of these are recognised, but strange to say there does not occur any mention of zinc. Later on, 9 metals are named including two alloys, brass and bell-metal, after the 9 planets, the significance of which will be discussed in the proper place.

The date of Sāṅgadhara can be ascertained with accuracy, as besides this medical compendium he is the author of the Pad-dhati, a voluminous miscellany, containing, with other matters, a poetical anthology. The author dates his work in *samvat* 1420 or A. D. 1363. The name of the author's father is Dāmodara and that of the grandfather Rāghavadeva. The latter was highly considered by Rāja Hamīra, the Chauhan.♦

♦ After the sack of Chitor by Alī-ud-din in A. D. 1303, Mewar was occupied by the garrisons of Delhi. Hamīra

There is a big commentary on this work by A'dhamalla, whose ancestors settled in the city founded by Hammira.*

Rasendrasārasamgraha : The author, Gopalakrishna, begins by admitting that his treatise is a mere compilation based upon many Tantras, though he mentions by name only two, namely, Rasamanjari and Chandrikā. Special stress is laid on the therapeutic

recovered his ancestral throne and during his prosperous rule of sixty-four years (1301-1365) and that of his successors arts and literature found liberal patronage (*vide* Tod's "Annals of Rājastan"). The court of Hammira attracted another distinguished physician named Saugata Sinha as we gather from the colophon to a noted recipé.

१४। श्रीमतसिंहमायमिष्टका चार्के ददावीष्टकः
उच्चीराव महोमुखे ॥ श्रीमद्भागवतः

* A'dhamalla gives an account of his family. His Grand-father was one Chakrapāni, not to be confounded with the celebrated medical author of Bengal (Vol. i, Intro. liv) and he himself was attached to the court of a ruler named, Jaitrasimha, whose capital Hātsikotapuri was situated on the river Charmanvati. We reproduce in the next page the text which is somewhat corrupt from the copy preserved in the Library of the Sanskrit College, Benares.

tic efficacy of mineral preparations. Like Rasendrachintāmani it assigns a minor place to the ancient Ayurvedic method of treatment by kashayayoga, i. e., by herbs and simples; as far as the knowledge of chemical processes goes, it must be held inferior to the former. Numerous medicinal recipes

वीराक्षकुषदकामनवी ये पूर्वका विकृताः
शोषणीरपुरे • • • •
गदवये च वडना प्रदिद्वीचहपाचिः कुषकेरवेतुः(न्तु)
• • • • • • • •
वज्र शुहितमवज्र तम्भी लापतिं ह इति धूपतिमाणः ।
• • • • • • • •
तवाक्षरी दीर्घमति वडलो लाकादमङ्गो • •
तेज • • वीराक्षरे (?) (विनाक्षरे) लार्ज्जरवेत्तासः ।
हालोकाकपुरो पुरा पुरविता लाक्षीय विहवने-
स्यांसा वज्र सरःसरिष्टवरता चक्षेत्ततो वापदा ।
यस्ता छहतवासुदेववरवहनाम्बुजः लापतिः
काली चक्षेत्तवासि चक्षेत्तिषु दीर्घमसिंहः प्रभुः ॥
तवां लार्ज्जरोक्षानां योक्षानां च लक्षातिनी ।
क्षियते सादृशेन संहिताणाः पदीपिष्ठा ॥

* For a description of some of these vide "Journal des Savants," April, 1898.

agree word for word with those in *Rasendrachintámani*, which only proves that both have drawn on a common stock. There is no question of the one borrowing from the other, as internal evidence proves that both belong to the same period. *Abhayánanda Gupta* in the preface to his edition says :—“There is a tradition to the effect that *Gopála Kavibhúshana* of *Dakshina Vanga* is the compiler of this book ; but this can scarcely be accepted as he lived not long ago.” Again. “Its commentator, *Rámasesa Kavindramani* (author of *Arthabodhiká*) was court physician to Nawáb Jaffer Ali Khan of Bengal (Mir Jaffér) some 200 years ago.” *Rámasesa* himself quotes from 8 commentaries of this book ; hence it was recognised as of some degree of importance at that time and must have been composed long before. This work is very popular in Bengal and is a *raule mecum* of the local *Kavirájas*.

Rasendrakalpadruṇa is another work of this period. It deals chiefly with mineral preparations and is a mere compilation from

Rasārṇava, Rasamāngala, Ratnākara, Rasāmrīta and Rasaratnasamuchchaya ; the numerous citations with which it is replete are of some use in correcting many doubtful readings in these latter. Our MS. is incomplete, the first few couplets and the sequel being lost ; for the opening lines of the work see Aufrecht's Catalogue of the Bodleian Library, MSS., pt. 1, p. 321.

Dhāturañnamālā : This epitome is devoted exclusively to short processes of killing metals and minerals. Six metals are recognised at the outset, namely, gold, silver, copper, lead, tin and iron as in the ancient works; but strange to say later on *kharpara*,^{*} which is the mineral calamine, is taken as synonymous with jasada or zinc. We have before us a MS. procured from Benares. It is full of corrupt readings. The copy noticed in the Bodleian Library Catalogue seems to be more correct. From the colophon in the latter we learn that the author is one Devadatta of Gujarāta, but in the Benares exemplar

* Vol. i. p. 168.

this portion has been coolly tampered with, so that this poor compilation may be palmed off as an integral part of a *Samhitā* of the *Aśvinikumāras*, the divine physicians, and thus entitled to the respect due to revelation. This work cannot be placed earlier than in the 14th century. Here we have a serious sidelight into the history of literary forgeries.

CHAPTER IV.
MODERN PERIOD.
1500—1600 A. D.

We have now arrived at what may be termed the modern period in Hindu chemistry and *materia medica*. The characteristic of this period is that over and above opium, we have some other foreign drugs incorporated into the *materia medica*. By the beginning of the 16th century A. D. the Portuguese had fairly established themselves at Goa and some other parts of India,[•] and as a result of intercourse with them, that dreadful scourge—the venereal disease—had made its appearance. Sanskrit medical treatises from the Charaka and Susruta downwards and ending with Sarngadharā are silent about this malady though they give fairly

• The political influence of the Portuguese as early as 1533 A. D. is evident from the fact that Sultan Bahader, king of Gujaraṭa, entered into a treaty with them and through their assistance raised a force of 6,000 Abyssinians—"Memoirs of Humayun".

accurate descriptions of diseases of the genital organs (उवास). But syphilis had now to be reckoned with and a new name had to be coined for it. Accordingly we find Rasapradipa, one of the standard works of this period given to Tantric method of treatment, prescribing calomel and *chobchini* (China root, Smilax China, Linn) for what is now termed for the first time *Phirangaroga* or the disease of the Portuguese. According to Flückiger and Hanbury "the use of this drug as a remedy for syphilis was made known to the Portuguese at Goa by Chinese traders about A. D. 1535." Thus from an independent source we can arrive at the approximate date of Rasapradipa. This work also gives us a detailed process for the preparation of mineral acids by distillation which is here termed *samkhadravaka* (lit. a solvent for conch shells) and is described as "endowed with the property of dissolving metals." It is thus evident that the use of mineral acids as a solvent for metals was unknown in India before this time.● A very

● *Fide Note on mineral acids, vol. I. p. 185.*

noteworthy circumstance in connection with this is that the Bhāvaprakāśa, which is posterior to Rasapradīpa, is silent about saṃkhaḍrāvaka, which had come to be prescribed by this time as a favorite remedy for indigestion and derangement of liver and spleen ; the solvents being borax, treacle, etc.—(cf. vol. i, p. 130). In the Bhāvaprakāśa among the acids we have only the juices of acid fruits. This is only another instance of the danger one is liable to incur by drawing inferences from *argumentum ex silentio*.

Rasakaumudi is another compilation belonging to this period and as far as its contents go it is comparable to Rasapradīpa in many respects ; both opium and mineral acids are prescribed. From the colophon in the Calcutta Sanskrit College Library MS. we gather that the author is a physician named Mādhaba. Curiously enough he is often confounded with the celebrated Mādhavakara, the author of the Nidānasamgraha, who preceded the former by some 8 or 9 hundred years.

The next work which should now claim our attention is the well known Bhávaprákáśa of Bhávamisra. It is a voluminous compilation in which the Ayurvedic method of treatment has been mainly adopted and as such ample citations are given from the Charaka, Susruta, Vñgbhata, Hárīta, Vrinda and Chakrapáni. But the Tantric remedies could not altogether be given a wide berth and accordingly one or two chapters have been devoted to mineral preparations ; but these have been borrowed chiefly from Rasa-pradipa, Rasendrachintámani, Sáringadhara and other standard works. Bhávamisra has been scrupulously candid in his acknowledgments to the various authorities quoted by him. *Phirangaroga* is mentioned as also its treatment with the help of calomel and chob-chini. The author lived about the time of the Emperor Akbar and evidently in that part of India which is now known as the United Provinces and it is not to be wondered at that Mussulman influence is discernible in his book.

We conclude our survey of this period

with the notice of a remarkable production entitled Dhátukriyā or “operations with metals”; it is in the shape of a dialogue between Siva and párvatí; in short, it pretends to be a part and parcel of the Rudrayámala Tantra. • The work cannot be placed earlier than in the 16th century A.D., as it contains reference to the country of the *Phirangas* and to Rúma, the Arabic name for Constantinople. For the first time we come across the very appropriate term dágajala (lit. burning water) coined to denote sulphuric acid. The information about the metals is of very meagre and poor description and it has been needlessly spun into an inordinate length. The ‘author’ evidently cosiders it a pious fraud to make such statements as follow emanate from the mouth of Siva himself :—

“By using coins made of imitation gold one can carry on exchange . . . and thus enrich oneself.”

* We have in hand transcripts of two MSS.—one from the Library of the Mahárájá of Ulwar, the other named somewhat differently, Dhátumafjari, from Benares. They agree very closely.

The curious reader who is referred to the translations of the selected portions of the text given elsewhere will not fail to recollect similar passages in the Leyden Parchment where the dishonest goldsmith gives numerous recipes for "augmenting gold." • Fraudulent attempts in the direction of palming off alloys of base metals, possessing bright, yellow lustre, for gold, have been made in all ages and in all climes (cf. extracts from *Rasārṇava*, Vol. i, p. 74).

Arkaprakasa or a treatise on the preparation of medicinal tinctures and essences should also find a place here; † its authorship is ascribed to Rāvana, the mythical king of Ceylon. The contents of the work, however, reveal its date. For instance, mercury, treated with S'amkhadrāvaka, is prescribed as the remedy for "Phiraṅgaroga" (syphilis).

• Berthelot: "Collection des Alchimistes grecs" (trad. p. 287). "La Chimie au Moyen Age," T. I. p. 31.

† There is a Calcutta edition published by Gajesa Chandra Ghosh; we have compared it with a MS. procured from the Sanskrit College, Benares. They agree remarkably well.

Opium also is prescribed ; while the term *yasada* is used to indicate zinc. As a distilling apparatus a tinned copper vessel is recommended. Mahomedan influence is distinctly discernible in this hybrid production. The very title of the book is no doubt Sanskritised from the Persian *arrak* (essence).

It is unnecessary to proceed further. We have before us the MSS. of *Rasamanjari* by *Salinatha*, of *Rasarañjana*, of *Gandhaka-kalpa* (a Tantra), of *Rasarnava* (quite distinct from the standard work bearing the same title), of *Rasaratnakara* (altogether different from that of *Nityanātha*) and several others. As all of these repeat *ad nauscam* the processes already described, we refrain from examining their contents here.

CHAPTER V.

INDIGENOUS ORIGIN OF INDIAN ALCHEMY.

The reader who has been able to follow us throughout with patience will not have been slow to recognise that alchemy in India has been developed all along on independent lines. Its origin and growth are interwoven with a phase of religious activity—the outcome of purely indigenous traits—which has been discussed at length in chapter i.

The only instance in which we find some allusion to adepts outside the pale of Hindu institutions occurs in *Rasaratnasamuchchaya*.^{*} But the term *Mlechchha* used there is a generic one applied indiscriminately to

* म्लेच्छरत्नसमूहम्. *Vide* Vol. i, Sans. texts, p. 56; a variant in the Poona edition has भैरवरत्नसमूहम्, which must be rejected as both the Benares and Kāmrī MSS. accept the former.

the Sakas, the Yavanas (Greeks or Bactrians), the Chinas (Chinese), etc. The Hindus have never been shy of acknowledging their obligations to the Yavanas ; Varāhamihira for instance expresses his admiration for the proficiency of the latter in the field of astronomy and would gladly learn at their feet. In the Mahābhārata again we find the services of the Yavana architect, Purochana, requisitioned. We have not, however, come across a single passage, which may be construed into implying a hint to alchemists in the West. That the term Mlechchha in R.R.S. really refers to the Kiratas is evident from the colophon to Rasahridaya. †

Those scholars who have hitherto maintained that Indian alchemy is of exotic origin, have, we are afraid, done so on a priori

• वैका हि बदनासेव उच्चत शासनिर्द सित ।
सर्विष्टेऽप पूर्वको विं तुवद्वर्वाप्नुः ॥

^t Sans. texts, p. 39; there the four castes (*वर्ण*) are distinctly mentioned and the *kiratas* evidently included under the *Mlecchhas*.

grounds. Indeed the frame of mind which they have brought to bear upon this subject is not calculated to lead to a judicial and dispassionate verdict. The fact that the Hindus are indebted to the Greeks for substantial improvements in their astronomy is too often urged whenever it is necessary to support such a view.♦ There is, however, very little affinity in the mode of growth of alchemy in India and of its *cognate* in the West. The progress of magic, witchcraft and alchemy can be traced from the Atharva-

♦ Cf.—“It was, however, Greek influence that first infused a real life into Indian astronomy. This occupies a much more important position in relation to it than has hitherto been supposed; and the fact that this is so, *ex ipso* implies that Greek influence affected other branches of literature as well, even though we may be unable at present directly to trace it elsewhere.” Weber: Hist. Indian. Lit. ed. 1892, p. 251. In justice to Weber, however, we should quote here his views on the independent origin of Hindu medicine: namely, “the weights and measures to be used by the physician are expressly enjoined to be either those employed in Magadha or those current in Kalinga; whence we may fairly presume that it was in those eastern provinces, which never came into close contact with the Greeks, that medicine received its special cultivation.”—p. 269.

vedas onwards to the later Tantras according to the laws of evolution without any breach of continuity.

One of the most favourite doctrines of the neo-Platonists was that the metals were engendered in the womb of the earth under the influence of the planets. According to Olympiodorus (5th century A. D.) lead is begotten by Saturn, "electrum"• by Jupiter, iron by Mars, copper by Venus, tin by Hermes, gold by the Sun and silver by the Moon. † Now, such a fascinating astrological belief was pre-eminently calculated to appeal to the Hindu instinct, especially as there was a "commercial and lively intellectual intercourse," to quote Weber's own words, between Alexandria and the West Coast of India. Varahamihira's *Vrihat-*

• An alloy of gold and silver was known by this name. Later on it disappeared from the list of metals, tin being assigned to Jupiter, and mercury to Hermes.

† The influence of the astral bodies on the production of the metals can be traced to Proclus' commentary on the *Timaeus*.—Berthelot: "Les origines de l'Alchimie;" p. 49; also Coll. des. Alch. Græc. trad. p. 100.

hitâ, if anything, is a repertory of astrological notions. In vain do we look even there for any such chance and solitary reference.♦ The alchemical literature of India is equally silent about it. † True it is there are two metals which are often designated as the sun and the moon respectively, namely copper

♦ Chapter xvi of this work treats of "countries, people and things belonging to the domain of each planet." Among sundry other things "the Sun is the lord of gold and fire." Thousand and one articles are said to be presided over by the Moon, Mars, Mercury, Jupiter, Saturn, Venus, Râhu and Ketu; but nowhere is there any connection between the planets and the metals. *Vide Kern's trans.*, pp. 97—101.

† The mythical origin of some metals is given in the Purânas; but no reference to the astral bodies is to be found. Thus silver originated from the tears of the God Siva, copper from the semen of the God Kârtikeya, lead from the semen of the Snake God Vâsuki, iron from the different parts of the body of the demons called Lomilas; and gold from the semen of the God of fire. Some vague and remote connection only can be established between this sort of nomenclature and that of the old Greco-Egyptian alchemists. According to the latter mercury is sometimes designated as the semen of Hermes; whilst in the Tantras it is the semen of Siva (हर्षी). *Vide "Intro. à l'étude de la chimie des anciens,"* p. 11.

and silver.♦ But this has nothing to do with the planetary generation of these metals. In the imagery of the Sanskrit poet the crimson tint of the rising sun and the pale white lustre of the moon are comparable to the colour of copper and silver respectively.

The old Greek writers repeatedly refer to the mystic relationship between the seven planets and the seven metals. In the Sanskrit literature, however, beginning with the Susruta and coming onwards to Rasaratna-samuchchaya, we invariably find six metals recognised, alloys being rigorously excluded from the list and regarded simply as "artificially made." † It is only in the Sāṅgadharā and other later works that we find seven metals enumerated ; ‡ but this author

* रसि, चक्षुः and other synonyms are as a rule applied to copper but rarely to gold.

† *Vide Vol. i, pp. 48, 72 and 127.*

‡ (चार) brass being taken as the additional metal ; zinc was evidently unknown to Sāṅgadharā.

संस्कृतारात्रावाचि नामवही च दीप्तिवद् ।

चारहै सप्त विद्येशः ।

is guilty of a curious inconsistency, since in a subsequent part of his book he adds two more to the list and quietly lays down that there are nine metals, which derive their names from the nine planets.● This may be read as a sort of vague and indistinct connection between the metals and the astral bodies.

The Arabs who adopted many of the Greek doctrines of alchemy also represented the seven metals by the seven planets. In fact it was through the medium of the Arabs

● "Kamsya" (bell-metal) and "Vrittaloha" or "Varataloha" (cf.—Vol. i. p. 114) make up the number. Rāhu and Ketu are the two mythical planets; they are in reality the ascending and descending nodes in the ecliptic. Rāhu is supposed to cause the eclipses of the sun and the moon by swallowing it up.

Sārigadharā stops here, but his prolix commentator, A'dhāmalla supplies the deficiency by making copper stand for the Sun, silver for the Moon, brass for the Mars, iron for Saturn, gold for Jupiter, tin for Venus, lead for Mercury and bell-metal and vartaloha for Rāhu and Ketu respectively.

It will also be noticed that lead is here represented by Mercury; but in the Hindu alchemy mercury always stands as the visible manifestation of the God Siva, it being generated from his semen, hence the name शृणु given to it.

and the Jews that a knowledge of the Greek sciences including alchemy filtered to the European nations during the middle ages. • We have already seen that Rajputana had been overrun and even occupied for a brief period by the Mussulman conquerors shortly before the time of Sāringadbara and it is reasonable to suppose that he had gleaned some astrological notions from that quarter.

We now advert for a moment to the main question of the connection of the comparatively modern and scientific phase of Hindu astronomy with the science of Alexandria. Although it is admitted by all those who are entitled to speak with authority on the subject that the Hindus borrowed from the Greeks and thus improved upon their older system, many points have yet to be cleared up. Professor Whitney who has

• "C'est par l'intermédiaire des écrits arabes et hébreux que la plupart des connaissances scientifiques des Grecs en mathématiques, en astronomie, en physique et en médecine, ont été transmises au moyen âge occidental; les écrits Grecs proprement dits n'ayant guère été connus directement avant la Renaissance."—"La chimie au Moyen Âge," T. i. p. 229.

carefully studied the subject is struck with the circumstance that the Suryya and other Siddhāntas bear resemblance to the system of Hipparchus rather than that in the Syntax. In other words the transmittance of astronomical knowledge must have taken place before the time of Ptolemy. Now the period of lively intercourse is precisely that covered by the age of Ptolemy and that of his followers, and yet the Indian astronomers seem to be unaware of his teachings.†

* *Intro. to "Suryasiddhānta"*. We find from Ptolemy that the observations of Hipparchus extended from B. C. 162 to B. C. 127. Ptolemy flourished at Alexandria in the second century A. D. under the reigns of Adrian and Marcus Aurelius.

This was also pointed out long ago by Colebrooke, e. g. "The whole cluster of astronomers mentioned by Brhbha Gupta must be placed in the interval between the age of Hipparchus, and possibly that of Ptolemy."—*Essays*, pp. 411—412.

† Āryabhaṭṭa composed his treatise "Laghvāryabhaṭṭīyam," in 496 A. D., and Varāhamihira his "Pāñcasiddhāntikā" about 550 A. D. But these astronomers borrowed from the much older treatise entitled "Romakasiddhānta" ascribed to Śrīsena, and Paśūnasiddhānta (*vide* Thibaut's *Intro. to Pāñcasiddhāntikā*, xxvii—xxxvi).

This mystery has never been elucidated : Dr. Thibaut's arguments are ingenious, but, we are afraid, by no means convincing. Indeed in the purely mathematical sciences the Hindus far excelled the Greeks of the Alexandrian school. A'ryabhatta's knowledge of algebra was superior to that of Diophantus and as for arithmetic it is generally acknowledged to be of Indian origin.^t

The last word on the subject has yet to be said and it is doubtful if this dark recess will ever be illumined. In the meantime it would be better to hold our judgment in abeyance. At best we can only launch into hypotheses

• L. c., pp. li and liii.

† Cf.—Colebrooke: "Admitting the Hindu and Alexandrian authors to be nearly equally ancient, it must be conceded in favour of the Indian algebraist, that he was more advanced in the same."—*Essays*, ii, 429. Again, "in the whole science he [Diophantus] is very far behind the Hindu writers," *ibid.*, p. 438.

Kaye has recently questioned the priority of the claims of the Hindus : *Vide J. A. S. B.* iii [N. S.], July, 1907.

or indulge in dogmatic assertions.●

• One who approaches this subject should divest himself of prepossessions or the "bias of patriotism" as Herbert Spencer puts it. A very agreeable feature in this controversy is that those who are most competent to speak with authority are extremely modest, nay diffident [in giving expression to their views. Worpcke in his masterly memoir "on the propagation of the Indian numeral symbols" says:—"La solution parfaite de ces problèmes ne résulterait que d'une connaissance tellement complète des événements et de leurs phases, qu'il faut à peu près renoncer à jamais l'obtenir. D'un autre côté, remplir les vides par des hypothèses arbitraires au préconçus servirait livrer l'histoire des sciences aux hasards et au dogmatisme des inspirations individuelles." "Journal Asiatique" (1863).]

Kamen whose modesty is only equalled by his profound scholarship observes:—Es wäre sehr wünschenswerth, dass ein mit der gebührigen Kenntniß der Sanskritsprache ausgerüsteter Kenner der Mathematik und Astronomie es unternähme, aus diesen vorhandenen Hülfsmitteln die Lücken unserer Kenntniß auf diesem Gebiet des Indischen Alterthums auszufüllen; für jetzt müssen wir uns darauf beschränken, die hauptsächlichsten Ergebnisse der bisherigen Untersuchungen zusammenzustellen." "Indische Alterthumskunde." Vol. ii. p. 1150; ed. 1874.

CHAPTER VI.

SOME NOTED INDIAN ALCHEMISTS AND THEIR WORKS.

Aufrecht in his notice of the MS. of *Rasaratnasamuchchaya*,^{*} evidently from a mistaken notion that the pursuit of chemistry was unknown in ancient India, goes somewhat out of his way in asserting that the names of the 27 alchemists, mentioned in the beginning of that work,[†] are mostly apocryphal. We have, however, positive proofs that these personages far from being evolved out of the imagination of the author existed in real flesh and blood and contributed not a little to the progress of chemical science. Thus we read in *Rasaratnākara* of "chemical operations performed by Māndavya" and also find Ratnaghosha taking part in a dialogue on certain processes, [‡] Yaso-dhara, again, is the author of the comprehensive work named *Rasaprakāśasudhākara*.

* Catalogus Catalogorum. II. p. 116.

† Vide Vol. I, p. 77.

‡ Eng. trans. pp. 6—8.

which we have noticed at some length in the present volume. Vyādi is a prominent name both as a grammarian as well as a chemist. The *Garudapurāna* quotes him as an authority on gems.♦ Nandi, as we have already seen, is distinctly referred to by Soinadeva as the inventor of the *koshthi* apparatus and of the process of sublimation. †

There are, indeed, a great many names scattered throughout the mass of chemical and medical literature, some of which have been handed down to posterity, sometimes on account of the important processes they invented and sometimes, again, because of the efficacy of the metallic preparations which they introduced. Thus in *Rasendra-chintāmani* we come across the name of Siddha Lakshmisvara. The names of the sage Brahmajyoti, Manthānabhairava, Svachchhandahhairava and Gahanānandanātha have in this manner been rescued from oblivion. Most of these were Buddhist monks.

♦ व्यादिं चाह अवता ति नष्टामायः जिदो विद्युत्प्रियतरया दशात् ।

† Intro. iv.

Sivadāsa in his commentary on Chakrapāni quotes besides Patañjali, Bhavyadattadeva as an expert on iron preparations. We give below the names of some of the authors and their works over and above those already noticed. It is scarcely possible to submit an exhaustive list.

Name of the Author.

Name of the work.

Anandānubhava	Rasadipikā.
Balabhadra	(Unknown).
Bhojadeva	Rasarajamrigānika.
Chandrasena	Rasachandrodaya
Charpañca	Charpatasiddhānta.
Dhanapati	Divyarasendrasāra.
Garudadattasiddha	Rasratnāvali.
Gorakshanātha (Unknown)	Gorakshasamhitā.
Gorakshanātha (Unknown)	Rauddhakarvavā.
Hariharā	Rasavisvadarpana.
Kañkālī	Rasakañkālī
Kapāli	Rasarajamahodadhi.
Kesavadeva	Yogaratnākara.
Mallāri	Rasakautuka.
Narahari	Rasayogamuktāvali.
Bāmarāja	Rasaratnapradipa.
(Siddha) Bhāskara	Rasendrabhāskara.
(Siddha) Prāṇanātha	Rasadipa.
Srinātha	Rasaratna.
Trimallabhatta	Rasadarpaṇa.
Vaidyarāja	Rasakasnayavnidiyaka.
Vandimisra	Yogasudhānidhi.
Vāsudeva	Rasacarvesvara.

The Tantric Period

(Continued).

Chemistry in Rasaratnakara of Nagarjuna.

[In the rendering of Rasaratnakara of Nāgārjuna and other Sanskrit texts we have often given only free translations. Such passages as are unnecessary repetitions or are not of sufficient interest to the general student of the history of Chemistry have been left out.]

CHAPTER I.

I shall now speak of the purification of the important rasas (minerals).

What wonder is it that rājāvara digested with the juice of *Acacia sisso* converts silver of the weight of one gunja into one hundred times its weight of gold of the lustre of the rising sun ? 1

* Regarding rasas see Vol. I, p. 70.

What wonder is it that yellow sulphur, purified with the juice of *Butea frondosa*, converts silver into gold when roasted thrice over the fire of cowdung cakes ? 2

What wonder is it that calamine.....roasted thrice with copper converts the latter into gold ? 3

* These laconic recipes all refer to the floating mass of traditions current at the time of the author on the transmutation of the base metals into gold. As they are of a fragmentary and disjointed character, the meaning is not always clear. Recipe 3 also occurs in *Rasārṇava*; *vide* Vol. i, pp. 70-71. Various ingenious methods were resorted to for debasing gold or making an alloy, which would mimic the appearance of this metal. Silver, copper, lead, zinc and mercury were often made into an amalgam, and the latter rendered compact and coloured yellow with the aid of orpiment. No wonder that the law-books prescribe several penalties on the fraudulent debasers of the precious metals. Thus according to Manu "the king shall cause a gold-smith, who behaves dishonestly, the most noxious of all the thorns, to be cut to pieces with razors." IX, 292.

The reader who feels interest in this subject may consult Berthelot's "La Chimie au moyen Age," t. I, pp. 31 et seq., where will be found several recipes for augmenting gold *aurum plurimum facere*, or for the "fabrication of gold." One example may be cited here. "Take gold, copper and mercury, make an amalgam of the whole, afterwards add sulphur, orpiment, "mandarac" (a kind of resin) and the bile of the vulture &c." The author of the recipe thus concludes:—"Thou wilt now discover a secret, which is sacred and worthy of praise" (l. c. p. 35).

What wonder is it that cinnabar digested several times with the milk of the ewe and the acids* imparts to silver the lustre of gold glowing as saffron ? 4

Digestion [of minerals] is to be effected in the decoction of *Dolichos uniformis*, *Paspalum acrobicratum*, the urine of man and the acid juices of [the fruit of] ratan (*Calamus rotang*) and afterwards with the addition of the alkalies (soda, borax &c.) The operation of roasting is to be performed thrice.—Cf. the process of *Rasnratnasamuchchaya* (R. R. S.), Bk. ii, 67-68 in Vol. i, p. 83.

What wonder is it that the pyrites macerated in the juice of *Musa sapientum* and in castor oil and clarified butter, and placed inside the bulb of *Arum campanulatum* and roasted [in a closed crucible] undergoes perfect purification ? † 6

Chapala and other minerals, being macerated in the juice of the lemon for 3 days, become purified. Gold being smeared with the 5 earths, the ashes and salts ‡ and roasted, undergoes purification. 12.

* Vegetable acids are meant here. *Vide* Vol. i, p. 123.

† Here extraction of copper from the pyrites is no doubt meant.

Cf. R. R. S. Bk. ii, 89-90; *vide* Vol. i, p. 84.

‡ Cf. R. R. S. Bk. i, 71, 83; *vide* Vol. i, pp. 128-129.

Silver alloyed with lead and fused with ashes becomes purified.* 13

Lo! it is not to be wondered at that copper, melted with the alkali derived from the earth† and the milk of the ewe, clarified butter and one-sixteenth of its weight of oil, will become pure like the crescent of the moon. 14.

Veres 23-25 : Extraction of the essence of vaikränta : exactly the same as in R. R. S. Bk. ii, 71-72. *Vide Vol. i, pp. 83-84.*

Veres 26-30 : Have reference to the extraction of copper from mākshika and tāpya (varieties of the pyrites). They agree in all essentials with Rasārṇava, Ch. VII, 12-13. *Vide Vol. i, p. 70*

Veres 31-32 : Extraction of zinc from calamine. Cf. R. R. S. Bk. ii, 163-164. *Vide Vol. i, p. 88.*

Veres 35-36 : Exactly the same as in R. R. S. Bk. ii, 103-104. *Vide Vol. i, p. 85.*

Veres 37 : Essence of darada, i.e. extraction of mercury from cinnabar by distillation. Cf. R. R. S. Bk. i, 82-90. *Vide Vol. i, p. 78.*

* Refers to cupellation. Cf. Rasārṇava in Vol. i, p. 68, foot-note (1).

† वृष्णीमवेष चरेष may refer to metron or to saltpetre.

Veres 50-51 : Dissolution of gems (pearls &c.) by digestion in vegetable acids, e. g. sour gruel (impure vinegar) and the juice of certain acid plants.

Here ends Chapter Second of Rasaratnakara by Nāgārjuna on the killing of diamond and the metals, extraction of the essence of minerals and liquefaction of mica.

CHAPTER III.

I shall now explain [the process of] fixation of mercury. The king of rasas (mercury), rubbed with the juice of lime, sal-ammoniac, the acids, the alkalies, the 5 salts, *Piper nigrum*, *P. longum*, the dried root of ginger, the juice of *Moringa pter.*, the tuber of *Amorphophallus campanulatus*, can readily amalgamate itself with the 8 metals. 1

* * * * *

Prajñāpāramitā (perfection of wisdom) appeared before Nāgārjuna at midnight in a dream and revealed to him the ingredients of a recipe (consisting of steel, copper, mica, pyrites, &c.) 4

Mercury is to be rubbed with its equal weight of gold and then [the amalgam] further admixed with

sulphur, borax &c. The mixture is then to be transferred to a crucible and its lid put on and then submitted to gentle roasting. By partaking of this elixir (*i.e.* the sublimate) the devotee acquires a body not liable to decay. 30-32

I shall now describe the Garbha yantram.
62-65

Recipe for Kajjali or urthiops mineral.† 84-86

* * * * *

Having made salutation to all the Buddhas, free from the taint of sins, I shall now deliver the Kakshaputa tantra ‡ for the benefit of suffering humanity.

[The most important part, from an historical point of view, is the dialogue between Nāgārjuna, King Sālivāhana and Ratnaghosha.]

Nāgārjuna, whose end (salvation) had been attained, benevolent towards all living creatures, blessed with all favours, residing on mount Srivatsa, before him stood Ratnaghosha with folded arms.

* The same as in Rasāraṇa. *Vide* Vol. i, p. 66.

† The process is practically the same as in Chakrapāni; *vide* Vol. i, p. 58.

‡ There is extant a Tantra, which goes by this name, the reputed author of which is Nāgārjuna.

saying : "Be pleased to communicate to me knowledge on chemical operations."

Nāgārjuna said :—

Well done ! well done ! I am pleased with your devotion and shall convey to you all that you want to know, namely remedies for warding off wrinkles, grey hair and other signs of old age. Mineral preparations act with equal efficacy on the metals as on the body (human system). *

• • • •

For the benefit of living beings I went through all manner of penances for 12 tedious years and worshipped the goddess Yakshini presiding over the *Picus religiosus*. Then I heard an oracle.

Nāgārjuna said :—

O Goddess ! if thou art propitiated, be pleased to communicate to me the rare knowledge of the fixation of mercury.

• • • •

Sālivāhana said :—

I have dedicated to thee, O Goddess ! treasures of gold and gems, now I await thy instructions.

* This was a favourite metaphor with the alchemists. Cf. Vol. i, Intro. lxvi.

HINDU CHEMISTRY

The Goddess said :—

Well done ! well done ! O wise ruler ! I shall speak to you of chemical operations performed by Māndavya.* A disciple should be intelligent, devoted to work, sinless, and master of his passions. †

The apparatus known as koshṭī, mouth blow-pipe, cow-dung, substantial wood* (as fuel), a pair of bellows, iron plates, • • • having collected all these, chemical operations are to be performed.‡

* * * *

Ratnaghosha said :—

Having prepared with great care "the powder of projection," which transforms a ten million times its weight of the base metal into gold, § • • •

Nāgarjuna said :—

I shall convey to you what has been experimented upon by Sākānda. ¶

* * * *

* A well-known alchemist ; one of the 27 adepts mentioned in the opening lines of R. R. S. *Vide* Vol. i, p. 77.

† Cf. "Initiation into discipleship" in V.J. i, p. 115.

‡ Cf. Rasārṇava in Vol. i, pp. 64-65.

§ कौटिली नहारः—the term नहारः has technical meaning. Cf. Vol. i, p. 120.

¶ We are unfamiliar with this name, probably the reading is corrupt.

Tests for *killed* mercury.

The first two couplets are almost the same as in Rasarnava. Cf. Vol. i, p. 74.

When the quicksilver, which has acquired the colour and the lustre of the rising sun, stands the test of fire (i. e. is not readily volatilised), then it is to be regarded as *fixed*.

Here follows a list of apparatus borrowed from Rasendramangala—Detailed account of most of these will be found in R. R. S. Bk. ix. *Vide* Vol. i, p. 67.

**Chemistry in Rasahridaya
of Bhikshu Govinda.**

Quicksilver digested with sour gruel and then subjected to distillation is freed from [the impurities of] lead and tin. 1

Much the same as above. 2 • • • •

Description of the apparatus for purification of mercury by sublimation and distillation: it agrees almost literally with that given in R. R. S. Bk. ix, 68. *Vide* Vol. i, p. 121.

Patala vii.

Ingredients for making a vida for killing metals. Cf. Rasārṇava, IX, 2-3. *Vide Vol. i, p. 72.*

Preparation of mild alkali from the ashes of plants :—

The process must be considered as a poor one, compared to the elaborate description in Susruta. Cf. Vol. i, p. 82.

Patala viii.

• • • Alum, blue vitriol :—all these severally or collectively are favourable for imparting colour to quicksilver. *

Experts [on the properties] of metals are of opinion that tin gives strength, tikshna colour, lead unctuousness, copper all these qualities [to mercury.]

Couplets (in p. 29, Sans. texts) : The purport seems to be that when mercury is rubbed with certain sulphides, e. g. orpiment, pyrites &c., and sub-

* The text is not very intelligible. The other ingredients mentioned are tikshna and kanta, these being varieties of iron ; but iron will not amalgamate with mercury. Tikshna may also mean a kind of saline earth. The old alchemists racked their brains in devising ingenious processes for robbing mercury of its fluidity and imparting to it various colours. Cf. Rasārṇava, IX, 2-3, XI, 197-198. *Vide Vol. i, p. 74 and also "The Hindu method of manufacturing calomel,"—ibid. p. 260.*

limed, it assumes the colour of lac or *Coccinella* insect (a poetical and figurative way of expression for red colour) in the shape of the red crystalline sulphide.

Patala ix.

Vaikrānta, kānta, sasyaka, mākshika, vimala, adri, darada, rasaka :—these are the 8 rāsas* and their essences are well suited for chemical operations.

Sulphur, gairiks, kebiti, khechara (mica), anjana, kankushika :—these are the uparnas. Cf. Vol. i, p. 89.

Gold and silver are the noble metals.

Copper, brass, tikshna and kānta (varieties of iron) are the essential or substantial metals; lead and tin emit fetid odours. Cf. Vol. i, p. 113, footnote (l).

The six salts are :—Sauvarchala, saindhava, chūlika (cal-ammonia), sāmudra, romaka and vidi. The alkalies are :—Sarjikākshāra, yavakshāra and borax. (*Vide* Vol. i, Index of subjects.)

Patala xi.

A cupel made of boneash (goat's) and lined internally with borax &c.

* Cf. Vol. I, pp. 79-81.

Colophon giving an account of the author :—

Madanaratha, King of Kirāta, teacher of mercurial lore, in whom the Goddess of the science of mercury and minerals (Chemistry), the source of all good, has taken her abode for the benefit of mankind, who can restore to the disfigured patient, afflicted with leprosy, the healthy comeliness and lustre of youth :

Bhikshu Govinda, well versed in chemical operations and loaded with honours by the King of Kirāta, composed this tantra entitled "Rasabridaya."

This tantra is written by Govinda, the grandson of Maṅgalavishnu and son of Śrīmanovishnu :—
May Tathāgata pronounce his blessings.

Chemistry in Kākachandesvari-mata Tantra.

Paṭala i.

The first paṭala gives the origin (mythical) of the tantra.

Paṭala ii.

Kākachandesvari said :—

• • • Please, give a brief account of the

Chemistry of the metals, the killing of mercury and minerals and the fusion of the gems. 34

Sri Bhairava said :—

* * * Mercury rubbed with the ingredients of the *vida* (see Vol. i, p. 72) and roasted in a closed crucible, is killed instantly. That mercury now requires the power of converting a base metal into 1,000 times its weight of gold. 18-16

Copper, treated with the above preparation of mercury and rubbed with the acids, alkalies and the milky juice of *Calotropis gig.*, and roasted in a crucible, turns into gold. 18-20

Earth for making crucibles. 21-22 Cf. Vol. i, pp. 67-68.

Transmutation of iron into gold :—process not clear. 25-32

Pasala iii.

Liquefaction of mica :—

Thin plates of mica are to be smeared with the 3 alkalies and borax and strongly heated in a crucible. The whole mass fuses.* * * * 29-30

* Refractory silicates are treated similarly at the present day with the "fusion mixture."

**Chemistry in Rasendrachudamani
of Somadeva.**

Sans. texts, p. 51.

Tests for killed iron (rouge).

As R. R. S. has borrowed these from the present work, it is unnecessary to repeat them here.
Vide Vol. i, pp. 118-119.

Sans. texts, pp. 52-53.

Take lead of the weight of 30 palas and rub it with the milky juice of *Calotropis gig.* and calcine it till its weight is reduced to a karsha : this residue, even if it be calcined a thousand times, will not undergo further decay (i.e. diminution in weight). Metallurgists call this residue derived from lead Chapala.*

Tin also similarly treated will yield a chapala, which, on merely being touched with the hand, kills (fixes) mercury. This mercury is recommended for metallurgical and not for chemical purposes.

* Possibly it refers to lead derived from argentiferous galena. The lead, being cupelled off in the shape of litharge, will leave a button of silver, which will not undergo oxidation.

Sans. texts, pp. 53- 4.

[A somewhat complex process described, which is not very clear. We shall try to give the purport thereof. The quantitative measurements are of particular interest.]

1 pala of tin should be taken and rubbed with 10 nishkas of mercury and made into a cake with the addition of zinc ; it is then to be digested with the decoction of certain herbs and plants and warm vinegar and once more rubbed with $\frac{1}{2}$ pala of blue vitriol † and the juice of *Abrus precatorius*. The mass is then to be divided into small pills ; these should then be put into a crucible with the lid on and the fire to be urged by means of bellows. The essence is then to be taken out of the crucible. This essence of the weight of 10 *Sarasas* is then to be enclosed in a mixture of ashes and salts and roasted. This essence of the weight of 2 nishkas is then to be fused with 80 times its weight of lead • • • . This (essence) is also termed chapala. Cf. "the gold-like alloy" in Vol. i, pp. 74 75.

* रुद्राक्ष सूक्ष्म.

† पवार्द्ध सूक्ष्म.

Sans. texts, p. 55.

When quicksilver has been deprived of its physical properties (lustre, fluidity &c.) it is known as *vash/apiabha*. Cf. Vol i, p. 74.

Somadeva will now give a brief account of the apparatus, after having consulted numerous chemical tantras. (Here follows the description, which has been reproduced *verbatim* in R. R. S. *Vide* Vol. i, pp. 121 *et seq.*)

• • • • •

Urddhvapātana apparatus as described by Nandin. Cf. Vol. i, pp. 124-125.

Kośiki apparatus as described by Nandin. Cf. Vol. i, p. 69.

Chemistry in Rasaprakasa-sudhakara of Yasodhara.

Sans. texts, p. 57.

Preparation of *karpūrārassa* (lit. camphor of mercury, *i. e.* calomel) : practically the same process as given in Vol. i, pp. 250-51.

[Note. Calomel is prescribed here only as an aphrodisiac and a specific for leprosy but not as a remedy for syphilis.]

Sans. texts, pp 59-61.

Raraka (calamine) : the author of R. R. S. has evidently borrowed his description of this mineral from the present work. Cf. Vol. i, p. 87.

Extraction of zinc from calamine :

(The process agrees almost word for word with what is given in R. R. S. The essence possessing the lustre of lead runs out of the crucible.)

Sans. texts, pp. 61-82.

Saurāshṭī or tuvarī (alum-earth) almost identical with R. R. S. Cf. Vol. i, p. 91.

• • • The essence extracted from the alums (i. e. oil of vitriol) is to be used for operations with metals and not as medicine.

Sans. texts, pp. 62-65.

[Descriptions of various kinds of pits for calcining and roasting purposes are given ; as also their dimensions with the number of cowdung-cakes to be used as fuel &c. Cf. the typical roasting pit in Vol. i, p. 127.]

* * * *

Here ends Chapter X of Rasaprakāśasudhākara by Yasodhara, son of Padmanābha.

* In R. R. S. we have "the essence possessing the lustre of tin."

Sans. texts, pp. 65-66.

Hemakriā or process for the fabrication of gold : "I shall now speak of some curiosities of metals, partly from my own experience and partly from the classics on the subject. Calamine, cinnabar, copper pyrites and realgar are to be rubbed with the milky juice of *Euphorbia neriifolia* for 7 days together and then to be digested another 3 days. Melted copper or silver or lead, being alloyed with the aforesaid mixture, acquires the power of converting 100 times its weight of base metal into gold." • Cf. ante, p. 2.

Chemistry in Rasachintamani Of Madanantadeva.

Sans. texts, p. 68.

Svetabhasma : Cf. ante p. 16 and also Vol. i, pp. 250-51.

Sans. texts, pp. 69-70.

Two processes for the fabrication of gold :—
much the same as already quoted from Yasodhara.

Process for the fabrication of silver :—

Take 1 part of bell-metal, 2 parts of silver, 4 parts of steel (?) • • these to be fused with

* लकड़ी and लहरदी are technical terms ; for the meaning of लकड़ी see Vol. i, p. 120.

tin and borax ;—by this process will be made silver which will pass current for commercial purposes.

Sans. texts, p. 71.

Extraction of zinc from calamine :—

The process is much the same as given above (p. 17), whith this difference that, whereas Yaso-dhara bits off the completion of reduction when the flame issuing from the pot ceases to be blue, the present author directs that the pot is to be taken out of the furnace as soon as white fumes begin to appear. The crucible is then to be held in an inclined position so that the lead-like essence of calamine drops on the ground.

Chemistry in Rasakalpa (Rudra-yamala Tantra.)

Bowing to Siva, the lord of mercury, and also the feet of Chandikā, I write this Rasakalpa, the depository of mercurial lore.

CHAPTER 1.

Tests for killed mercury :—

Killed mercury is that which is devoid of (metallic) lustre, not so ponderous, white,[•] des-

* The author previously refers to the red, black, white and even yellow ash (calx) of mercury ; it is not clear why he should

troyer of metals, divested of fluidity and non-volatile when stirred over a fire. 40 Cf. tests in *Rasārnava* in Vol. i, p. 74; as also in *Rasaratnākara*, ante, p. 9.

Purified mercury should be preserved in the hollow of a tooth or gem or bamboo. 42

CHAPTER II.

Gold, silver, copper, tin, lead and iron—these are the 6 metals; vartalobha, &c., (Vol. i, p. 114) are simply alloys. 1

Honest readers! I beseech you with folded arms to favour my book with your merciful glance.

The mahārasas are 8 in number; e. g. mercury, cinnabar, sasyaka, rasaka, &c. the rasas are mica, green vitriol and rājāvarta, &c. sulphur, orpiment and realgar, &c. are the uparasas as regarded by learned teachers. Cf. Vol. i, pp. 79 and 89.

There are 4 kinds of sulphur:—white, black, yellow and red. Cf. Vol. i, p. 90.

• • • •

here restrict himself to the white variety only. Chloride or sulphide of mercury, when treated with a metal and heated, kills (i. e. parts with its chlorine or sulphur to) the latter and in that sense it is a destroyer of metals विद्युत्

The saurāshtris (alums) are of various kinds; the kāśīas (vitriols) are of 3 kinds,—namely, kāśīa proper, pushpa kāśīa and hirakāśīa.* Cf. Vol. i, p. 91.

Gairika is stated to be of 2 varieties,—the one of golden hue, the other red; Kankukūṭha and other rasas are also described by certain teachers; but these, however, are not referred to here, as we are treading in the footsteps of sages of old.[†]

Sans. texts, pp. 75-78

For the purification of mercury this process is recommended by Svachchhandaabbhairava and Govinda.

Chūlikalavani (Sal-ammoniac), sulphur and the ash of ginger, &c., digested one hundred times with cow's urine,.....make a vida for killing gold. Cf. Vol. i, p. 72.

This process for killing [metals] was revealed by Siva and has been transmitted by successive schools of adepts.

* Hirakāśīa is the name by which green vitriol is known throughout India; Royle supposes that this word is derived from the Persian *hara* green, and Sans. kāśīa. (Antiq. Hindu Med.) There is no necessity for looking upon hirakāśīa as a hybrid term, seeing that it occurs in the present work in which Mahomedan influence is nowhere traceable.

† Evidently Charaka and Susruta, who mention only a few commonly occurring minerals. *Vide* Vol. i, pp. 29 and 44.

Extraction of the essence of copper pyrites. Cf. Vol. i, pp. 70 and 84.

Extraction of zinc from calamine :—

The process is practically the same as given in R. R. S. Cf. Vol. i, pp. 87 88.

I have performed the [aforesaid] experiments with my own hands and have seen them with my own eyes. They are not recorded from mere hearsay or from the dictation of a teacher. These are being promulgated for the benefit of mankind.

Chemistry in Rasarajalakshmi of Vishnudeva.

Sans. texts, pp. 79-82.

Give an account of the common rasas and uparasnas. Cf. Vol. i, p. 79.

Chemistry in Hasanakshatramalika of Mathanasisimha, physician to the King of Malwa.

There are several prescriptions given in which mineral preparations play a conspicuous part. We have quoted only two ; in the first, among other ingredients opium occurs ; in the second, the

Svachchbandabbairavarasa, probably named after the celebrated alchemist, we have the calces of tin, iron and mercury along with other drugs.

Chemistry in Kasaratnakara of Nityanatha.

Sans. texts, pp. 84-86.

Test for killed mercury :—

When the substance, being heated over a fire of paddy husks, does not further decrease in weight, it should be considered as reduced to a calx.

Purified mercury should be stored in the hollow of a tooth or horn or bamboo.

Directions for making factitious cinnabar (Makardhvaja). Cf. Vol. i, p. 132 (footnote).

Chemistry in Dhaturatnamala.

In the beginning the author after salutation says: "I shall speak of silver, gold, copper, lead, tin and iron as also of calamine, mica, pearls, coral, orpiment, realgar, the pyrites, mercury and diamond,—in fact, the properties of all the metals and minerals and the mode of their incineration."

Killing of silver. Cf. Vol. i, p. 107.

Chemistry in Basapradipe.

Description for preparing mineral acids by distillation :—“*Sankhadravarna* or liquid for dissolving conchshells,—practically the same as given under “mineral acids” in Vol. i, p. 186. The last line says : “Cowrie-shells and metals dropped into the liquid are at once dissolved.”

Preparation of calomel and treatment of “phiranagaroga” (syphilis) with its application. Cf. Vol. i, p. 252.

Chemistry in Dhatukriya or Dhatumanjari (Budrayamala tantra.)

Sans. texts, pp. 98 et seq.

Tin, iron and copper are to be classed among the superior metals.

In general a metal being alloyed with silver is improved in quality. Sattvaja metal (i.e. an alloy of tin and copper, vide below couplet 15) is of middle quality. 12-14

Synonyms of the different metals. 39-49

Synonyms of zinc: Jāsatva, Yasadāyaka, rūpyabhrātā (lit. brother to silver), charmaka, kharpara, rasaka, &c. 50-51

* Yasada is the name commonly given to the metal extracted from calamine. Vide Vol. i, p. 156

Pittala is an alloy of copper and zinc. 68

Kāmavaka is an alloy of tin and copper. 65

Zinc being amalgamated with mercury gives rise to rasaka. 68

[*N.B.*—Rasaka and kharpara are the names generally applied to the mineral calamine (*vide* Vol. i, p. 158), but here they stand for the metal (zinc) or its amalgam.]

Lead being killed with the aid of gentle heat gives rise to minium (red lead). 69

Copper in combination with the "burning water" gives rise to tuttha (green vitriol).—Thus manifold operations are performed with the aid of mantras and apparatus : all these belong to the province of Chemistry. 70-71

Synonyms of haritala (orpiment) : Orpiment is a consumer of mercury and also a clipper of its wings.* 79

Synonyms of realgar, cinnabar, wicw, &c. 81-89

Synonyms of pearls, coral, tortoise-shell, conch-

* The sulphide of arsenic on being rubbed with mercury and gently heated converts the latter itself into the sulphide. The mercury is thereby killed and fixed i.e. deprived of its volatility (clipped of its wings—the Hindu alchemist's favourite figure).

shell, tusk of elephants, the tail of the peacock.
90-108

Localities for different metals. 113-121

[The information is very commonplace.]

Localities for copper specified : Nepāl, Kāma-rūpa (the eastern portion of Assam), Bangala, + the country of the Mlechchhas, Rūma and the country of the Phirangas, &c. 143-145

Localities for zinc : Kāmboja, Rūma, Balkh, &c. 146

Metals in combination with mercury and sulphur become fit for administration as medicine. 153
• • • •

Process of roasting a substance in a stout glass-vessel using goat-and-cow-dung-cakes and husks of paddy grains as fuel. 9 10

One part of gold and four parts of zinc are to be melted together and the alloy roasted in a closed crucible . . . the process repeated with the addition of alkalies . . . gold of a reddish yellow colour will thus be generated. 11-17

* All these have been placed under the category of (धीर) inferior dhāta. Though the term dhāta generally means a metal, it is often applied to a mineral ; here, however, it covers a much wider field.

† This is the name given to Bengal in many Tantras.

A process for making fictitious cinnabar by pouring mercury into its own weight of molten sulphur and then adding three-fourths its weight of orpiment The mass to be rubbed in a mortar and subjected to sublimation. 28-30

By using the *augmented** gold as a means of exchange one can amass wealth. 52

Tin is to be melted and one-hundredth part its weight of mercury to be amalgamated with it. This [fraudulent substitute for] silver can be used for purposes of exchange, and one can thus amass wealth. 85-88

Pure gold is to be alloyed with one hundred times its weight of copper and this [imitation] gold will resemble native gold. 88

Lead and copper being alloyed together will give rise to gold. 97-98

Colophon : Here ends the Chapter on the extolling of gold in Rudra-yāmala.

* Cf. footnote, p. 2.

Chemistry in Suvarnatantra or Svarnatantra.

The origin of the tantra is explained in the opening lines. Parasurāma having given away his worldly possessions to Kasyapa is rendered destitute, and thus has to invoke the aid of the God Siva for his very maintenance.

Siva said : Listen ! I shall now reveal to you the most wonderful mysteries of Svarnatantra. 1-10

A kind of oil is exuded from the bulbous root of a plant ; all around it within a radius of ten cubits oily water is exuded and a venomous snake lives under it. If you want to test the properties of the bulb, you should thrust a needle into it, and the needle at once dissolves. Having procured this bulb, rub it with mercury in a mortar and add the oil and subject the mixture to heat in a crucible. The mercury is at once killed and acquires the property of converting one hundred thousand times its own weight of the base metal into gold.* 14-18

Pure orpiment is to be rubbed with this oil for 20 days, and the former is killed thereby and loses its volatility. The 8 metals in the molten state being treated with this prepared orpiment acquire

* वारदी मैथ.

the power of transmutation. When the above oil is thrown into molten copper, it is turned into gold of beautiful lustre. Tin and bell-metal similarly treated are turned into silver, and copper, iron, brass and silver into gold. 19-24.

Sankhadravaka (*aqua regia*, see ante p. 24) is spoken of as an universal solvent This solvent with mercury is to be placed in a glazed crucible and subjected to heat; the mercury, thus killed, can convert the 8 metals into gold. By partaking of this mercury one becomes immortal; even his urine and faeces can convert copper into gold.* 1-10

* This sort of belief was prevalent also at the time of the composition of Rasa-rava.

Knowledge of Gems.

A few words on gems may not be considered beyond the scope of the present work especially as the subject has already drawn the attention of some European scholars.* We shall, however, limit ourselves, as far as possible, purely to the physical and chemical properties of the precious stones.

It has already been seen that among the 64 branches of arts and sciences recognised in the ancient 'Kāmasūtra' of Vātsyāyana occur the following :—(a) the testing [of the genuineness or otherwise] of gold and the gems; (b) knowledge of the colouring of gems, as also of mines and quarries.† Varāhamihira (d. 587 A. D.) in his "Vṛihat Saṃhitā" also conveys much useful information on this subject, but as he in his turn refers

* Garbe in his "Indischen Mineralien" (Leipzig, 1882) gives the text and the translation of Ch. xiii of Narahari's "Rājani-ghānsu"; this work, however, is comparatively modern. Much useful information on the subject with bibliographical references will be found in Professor Yogesh Chandra Ray's treatise in Bengali entitled "Ratnaparikha."

† *Vide* Vol. i, p. 191.

to experts who preceded him,^{*} it may safely be concluded that long before this time it received adequate attention.

The *Garudapurāna* under the heading of *Ratnaparikshā* (examination of the gems) devotes several chapters to a detailed and fairly exhaustive description of the gems. This *Purāna* like so many of its class discusses on a variety of topics, mundane and spiritual ; in short, it may be looked upon as a sort of *mallum in parvo*.

From time immemorial the gems have been valued in India not only for purely decorative and ornamental purposes, but also as agents for warding off perils and the malignant influences of the planets and for securing luck and longevity. Hence it is that particular attention is paid to the testing of gems, as their virtue increases in proportion as they are faultless and flawless.

The typical characters which were most relied upon for differentiating one species of a gem from another were (1) the relative weight, (2) hardness, (3) lustre, transparency and colour, (4) fusibility, especially when heated in combination with the alkalies. It will be noticed that even the lapidaries

* शुभाचारः सम्मितः

and the mineralogists of the present day have to depend largely upon these properties in the classification of the stones. We shall now proceed to say a few words under each of the above characters following in the main the authority of *Garudapurāna*.

1. RELATIVE WEIGHT. We have purposely used these terms as contradistinguished from "specific gravity": as the latter connotes peculiar associations. The principle of Archimedes being evidently unknown among the Hindus, the measurement of volume could only be roughly approximate. To cite some illustrations. A stone may be of the same species as, and equal in volume to, a padmarāga (oriental ruby), but will differ in weight from the latter.*

Empirical and arbitrary scales of weight were adopted as standards. A ruby occupying the volume of a guñja (*abrus precatorius*) may be equal in weight to 10. 7 and 3 guñjas respectively. A ruby of the volume of a śrigālakola (a kind of jujube) should weigh 12, 8 and 7 guñjas respectively. Again, a ruby of the volume of an āmalaki (*phyllanthus emblica*) should weigh 30. 20

* गुण्डारक एवं गुण्डातीर्थी वा गुण्डान भवेद् गुणः।

and 16 māshās respectively. In each case the gem which is of greater weight is superior in quality and the value thereof is enhanced in proportion.^t

In the case of precious metals, however, adulteration was detected by an ingenious device, which may be regarded as a near approach to the principle of Archimedes. Suppose it is intended to test the purity of a specimen of gold. All that one has to do is to draw a wire of this gold and another of the standard gold through the self-same orifice [of corundum]. As these wires are of equal

* We give below the standard weights as current at the time of Varāhamihira.

8 White mustard	...	-	1 tändula (a grain of paddy)
4 Tändulas	...	-	1 gunja (<i>cörus precatorius</i>)
5 Gunjas	...	-	1 Māshā
16 Māshās	...	-	1 Karsha or suvarna or tolaka
4 Karshas	...	-	1 pala

The standard of weight has always varied in different times in different parts of India. 10 gunjas weigh about 18 grains. The seeds often vary in size.

+ Garuda lays special stress on the high specific gravity (=4.1) of a genuine ruby. गुडां रसितिष्ठः again गुडां गृहोन् गुडां यज्ञः। While high specific gravity is indicative of the excellence of the gems in general, in the case of diamond it is just the reverse. गुडां उत्तरदानी वीरवाक्षामकारम् । दक्षं तत् वैपरीत्येन दूरः विश्वसते ॥ It is not easy to account for this qualifying clause, seeing that diamond has a sp. gr. of 3.5.

diameters, equal lengths will have equal weights, provided the sample is pure.*

2. HARDNESS. There are many stones which in external appearance resemble a ruby; the spurious substitute may easily be detected by its difference in softness (low degree of hardness), and low specific gravity: again in case of suspicion the gem is to be rubbed on a whetstone; if it simply gains in lustre but does not lose in weight (by abrasion), the specimen is to be regarded as genuine (test of a ruby).† Diamond and corundum alone will scratch ruby and sapphire. Skilful lapidaries often make imitation diamonds of zircon, ruby, cat's-eye, rock-crystal and glass; hence they are to be tested by calling in the aid of learned experts. All the gems occurring in this world as also the metals will be scratched by a diamond, but the latter will not be similarly affected by the former.A diamond alone will scratch a diamond.‡

* ऋग्वेद समाजाद समवाक्ये हर्षीर्वदा :

पात्रोः दृष्टं मानसम् निर्दुर्दलम् भवितव्याः ॥ Sukrasti.

† This is true in a qualified sense only. After the diamond corundum is the hardest of all known minerals.

‡ The ruby and the sapphire are only varieties of corundum. Varaha classes corundum as a species of ruby, the former being dotted over with black and white patches and feeble in lustre (i.e. the non-transparent or coarse kind). It is scarcely necessary to

To the above tests Rājanighantu adds another, namely, when a diamond is struck with an iron hammer, it is not broken to pieces.

point out that the very word "corundum" is derived from the Hindi *kurānd*, a corrupt form of the Sanskrit *kuruvinda*. The statement "corundum will scratch ruby and sapphire" is not strictly accurate. There are degrees of hardness among the different varieties of corundum, the blue sapphire standing first in this respect.

We give here the original texts of which we have given above almost a literal translation.

"सेहमेदो वहता चक्रं चक्रातिविष्टं चक्रं लाज्जवद् ।"
 "चाक्राति सदेषु चक्राति परिवृत्तिः ।
 हुता योऽप्यनामाभावं परिनामं न मुखति ।
 च चेष्टः चक्रातिस्तु चेदात्मे विक्रातवः ॥"
 "एषं वा कुरुवद्दं वा तिमुखात्मेन विनाशितः ।
 य अर्थं लंगान चतुं पश्चादिक्षणोद्धरीः ॥"

* The reading of the text is very corrupt. Garbe gives as many as 12 variants; that adopted by him seems to be on the whole reliable as also his rendering: "Wenn er mit anderen steinen oder Eisenen Hämtern geschlagen nicht springt." On account of its brittleness a diamond will readily be shattered into splinters under the blow of a hammer. The following extract from Bauer and Spencer's "Precious stones" (pp. 129-130) may prove of interest.—

"The hardness of diamond has often been confused with its fragility or brittleness. It has been supposed, especially in ancient and mediæval times that hammer and anvil may be shattered but not the diamond which lies between.

3. LUSTRE, TRANSPARENCY, COLOUR and other optical properties. Difference in lustre (लक्षण) is often regarded as a diagnostic feature of the gems. According to Varāha gems of superior qualities should possess coel (lit. waxy) lustre, be limpid and emit rich rays. Classification according to colour is often enjoined. For instance, a diamond may be perfectly colourless, or it may be yellow.

This statement was made by Pliny, the great naturalist of ancient days, who was killed in 79 A.D. at the first historic eruption of Vesuvius. He proceeded to say further that the fragmentation of a diamond may be effected by subjecting it to a preliminary immersion in the warm blood of a goat, but that even under these circumstances the hammer and anvil will also be broken ! According to Albertus Magnus (1200-1280) the blood is more efficacious if the goat has previously drunk wine or eaten parsley.

"Such being the views then held respecting the unbreakable and indestructible character of the diamond, it is easy to understand why the Greek word *adamas*, signifying unconquerable, should have been applied to this stone, although its application to the diamond is singularly inappropriate and inaccurate when its extreme fragility is considered. Many a doubtful stone has been submitted to the test of the hammer, with the belief that the blow would be resisted only if the stone were a genuine diamond. Probably many beautiful stones have been sacrificed to this old belief. As a matter of fact, diamond is easily fractured, a very moderate blow from a hammer sufficing for the purpose ; its perfect cleavage places it among the most brittle of minerals."

black, red or copper-tinted.* Stones which are translucent, opaque and of dull colour are inferior in quality. In the case of diamond special stress is laid on its displaying the colours of the rainbow [due to its high dispersive power]. Some gems have only one shade of colour (एकाकृत) others again two (द्विकृत)

The changes in colour which the ruby and the sapphire undergo under the influence of heat had evidently been carefully observed. This test is to be applied with extreme caution as in case the pro-

रथ धीरं वित्तं गरुदोऽपि (Varaha) वासुदेव (Garuda).

Yellow diamonds are unknown in India at the present day at any rate. "India can claim for its own all the finely coloured stones of blue, green and red, not however, yellow diamonds, which come mainly from South Africa." (Bauer and Spencer). Crystals of black diamond should not be confounded with the black carbonado.

+ Probably refers to dichroism. As has already been pointed out the red ruby and the blue sapphire are only varieties of corundum, which often occur in well-developed crystals belonging to the rhombohedral division of the hexagonal system. "The dichroism of the ruby affords a means whereby it may be distinguished with certainty from other red stones, such as spinel and the different varieties of garnet, which crystallise in the cubic system, and thus being singly refracting can show no dichroism." (Bauer and Spencer). "The dichroism of the sapphires of Siam is specially well marked."—*Ibid.*

per degree of temperature विष्टात् is exceeded, the stone may be materially injured.*

4. FUSIBILITY (LIQUEFACTION). It was well-known that all the gems with the exception of diamond would undergo liquefaction when strongly heated with a mixture of the two alkaline carbonates [now familiar in the Laboratory as the "fusion mixture"]. The liquid principle of gems रथा दृति was a favourite remedy with the Hindu Iatro-Chemists (Cf. Vol. i, p 103). As most of the precious stones belong to the corundum and the spinel group, they easily yield to treatment with sodium and potassium carbonates. In the case of the pearls it is recommended that they should be enclosed inside lemons and placed in a mass of paddy grains [for the sake of the warmth].

- वावन्म चक्रमेदधि पद्मरात्रोपदीषतः (?) ।
- इद्युनोद्युमविकाशात् द्वितीय सुमहातरम् ॥
- तद्यापि न परीक्षांसे गुच्छानामस्थितुर्वै ।
- अविरप्तो ममाप्तेषः वावचिदपि वावनः ॥
- चक्रिमात्रा(?)परिज्ञाने वावदीर्घैव दृष्टिः ।
- सीत्यन्वांशं भवेद्युभांशः एवः वावविद्युत्काः ॥ Garuda.

Cf. "The red ruby, at a high temperature, is colourless : on cooling it first becomes green, after which it gradually assumes its original fine red colour." (Bauer and Spencer). "The blue colour of the sapphire disappears on heating."—/bid.

GENERAL AND CONCLUDING REMARKS.

The crystalline character of the minerals is referred to in one or two places. All the old writers agree in describing the diamond as having 8 angles, 8 faces and 12 edges.* The octahedral form of the crystal is common in the diamond occurring in the neighbourhood of Panna in Bundel Khand. Rājānighānta further adds that the stone is often endowed with numerous faces and edges.† According to Rasaratnasamuccaya the female diamond is flattened and rounded whilst the neuter is rounded and obtuse-angled ‡ Vaikranta is also

* शंखः पात्तिनि भाराव एकटी दादेति । Garuda.

† "In most cubes of diamond, however, each edge is replaced by two faces,.....the twenty-four faces thus derived would, if produced or enlarged" sufficiently, give rise to the form known as the four-faced cube, or tetrakis-hexahedron. (Bauer and Spencer).

‡ The rendering of the description of diamond in R.R.S. (vide Vol. i, p. 100) is based upon a misreading. The correct reading is that adopted by the Poona edition, namely, चटाव वाहवाह चटाव "a diamond has 8 faces and 6 angles." The author evidently uses चटा and चौका in the same sense; there cannot be any confusion here, as distinct mention is made of the 6 angles. As a rule चटा and चौका are used synonymously. Thus in Varsha चटा is described as चौका; the commentator Bhāskotpala explains it चट मिर्चिकुर्मः चटचौकालिकः; "Rounded" (चौका); Cf. Bauer and Spencer. "The faces of diamond crystals differ from those of most other crystallised minerals, in that they are as a

(probably a mineral of the spinel group. *vide* Vol. i, p. 83) described as having 8 faces and 6 angles.

It is sometimes asserted that the phosphorescence of diamond was first observed in 1863 A. D. by the celebrated Robert Boyle. Bhoja (11th century A.D.), however, mentions this property. Faults in precious stones due to isolated grains of minute gravels etc., embedded in the mass [now technically called "enclosures"], are also referred to.^t

It may be noted here that what is generally known as the Indian or Tavernier's rule for determining the value of diamond can be traced back to a remote date. *Sukraniti* speaks of it as the "rule of squares,"[†] while *Varāha*, himself a great rule, much curved and rounded instead of being perfectly plane as is usually the case."[‡] p. 119. "Obtuse-angled" (कुरुक्षोषाण) in the crystallographic terminology should be rendered as "with corners truncated off."

* चम्पार्दि व दीप्तिः (phosphorescence in the dark).

^t बहुता सदयुत्तमी सेयाकोणः स्वातवः कुरुः ।
तुर्मिदा न सनोऽप्तः प्रश्नकरावृत्तमापदीया ॥ Barsha.

Here कुरुतवः and कुरुहराः no doubt refer of the minute pebbles (gravels) enclosed in the body of the stones.

‡ यदा दुवतरं वज्रं तत्त्वं रुत्तर्वदः; i. e. if a diamond weighing 1 rati be worth x, one of the weight of 4 ratis will be worth 2x.

mathematician, gives practically the same rule, though somewhat on an elaborate scale.*

It would be unfair to compare the progress made by the Hindus in this branch of knowledge in the 6th century A.D. and perhaps earlier with that of the present day. Reference to the crystalline forms of diamond can be found in the writings of Kepler, Steno and Robert Boyle in the seventeenth century. Scientific crystallography originated with Romé de l'Isle and the abbé Haüy at the end of the eighteenth century. The various physical and chemical properties of the minerals called here bespeak considerable powers of keen observation.†

i. e. if a diamond weighing 20 tundulas (p. 33 ante) be worth 2 lacs (2,00,000), one weighing 5 tundulas will be worth only ($5^{\circ} \times 4 = 100$)th part of 2 lacs or 2,000.

† Concerning Ratnaparikshā cf. also "Les Lapidaires Indiens" by M. Finot in the "Bibliothèque de l' Ecole des Hautes Etudes."



NOTE ON THE METHOD OF PREPARING CAUSTIC ALKALI.

In the first Volume of our History the detailed description of preparing caustic alkali from the ashes of plants has been quoted at length from the *Susruta* and we referred to it "as a proof of the high degree of perfection in scientific pharmacy achieved by the Hindus at an early age."• M. Berthelot has no less been struck with the originality of this process; indeed, he goes so far as to suggest that this portion in the *Susruta* is evidently modern and in fact a later addition derived from contact with the European chemists.†

The process of rendering mild alkali caustic by the addition of lime is to be found also in *Chakrapāni* (c. 1050 A. D.) and *Vāgbhāta*, who must have preceded the former by several centuries, and it is well known that both these authors are deeply indebted to the *Susruta*. There is not thus the remotest chance of inspiration from the European chemists.

• *Vide Vol. I, Intro. c.*

† *Journal des Savants*, Jan. 1903, p. 42.

We have evidence from quite an unexpected and independent source that the cauterization of bad wounds by means of caustic alkali was an established custom in ancient India. Thus we read in "The Questions of king Milinda":—

"And when the inflammation had gone down, and the wound had become sweet, suppose he were then to cut into it with a lancet, and burn it with caustic. And when he had cauterized it, suppose he were to prescribe an alkaline wash Now tell me, O king ! would it be out of cruelty that the surgeon thus cut with the lancet and cauterized with the stick of caustic."*

* "Sacred Books of the East," Vol. XXXV, p. 168.

Although Milinda has been identified with the Bactrian Greek king Menander (c. 140—110 B. C.), it is not to be supposed that any Greek influence can be traced in it. In this ethical romance, king Milinda and the Buddhist Bhikshu Nāgasena have been put forward simply "as men of straw" to quote Rhys Davids. The work in reality conveys the teachings of the older Buddhists (Hīnayānists) with the background of Sāṃkhyā and Vedānta metaphysics.

The Tantrists, the Rosicrucians and the seekers after truth.

The East has not been always East and the West, West. Modern Europe is materialistic, but she has not disdained in the past to "plunge in thought." This reminds us of the truth of the poet's words : "one touch of nature makes the whole world kin." Ancient Greece had her orphic mysteries. They were developed into a religious and ethical system by Pythagoras. In the schools of Alexandria the neo-Pythagoreans and the neo-Platonists further added to it the Vedantic doctrine of a world-soul.

"With the dissolution of the neo-Platonic school in the sixth century, Greek philosophy disappears, it is true, as distinct phenomenon from the theatre of history, but it continues to exist in combination with foreign elements in the service of a new form of culture in the Science of the Middle Ages and of modern times." (Zeller).

Says Waite :—

"The traditions of the new-Platonic philosophy, with its elaborate theurgical system, were to some extent perpetuated through the whole period of the Middle Ages, for besides the orthodox theology of the great Latin Church and amidst the clamour of scholastic philosophy, we find the secret theosophy of the magician, the Kabbalist, and the alchemical adept borrowing, directly or indirectly, from this prolific

fountain of exalted mysticism. The traces of its influence are discoverable in Augustine, in Albertus Magnus, in St. Thomas, the angel of the schools, and in other shining lights of western Christendom, while the metaphysical principles of Johannes Scotus Erigena, even so early as the close of the ninth century, were an actual revival of this philosophy."^e

History repeats itself. In India the Yoga doctrines of Patañjali paved the way for the origin of Tāntric mysticism and it associated itself with magic and alchemy. Some twelve centuries later, this phase in the stage of human progress found exponents in the soil of Europe. As Waite says :—

"In an age of progress, of doubt, and of great intellectual activity, it is singular to remark the almost invariable prevalence of mysticism in one or other of its manifold phases, and the close of the sixteenth century beheld spreading over the whole of Germany and passing thence into Denmark, France, England and Italy, a mighty school of mysticism in the great multitude of magicians, alchemists, &c., who directly or indirectly were followers of the renowned Paracelsus."^f

^e"History of the Rosicrucians," p. 27. Regarding the sect of the Cabalists see also Lecky's "Rationalism in Europe." Vol. i, p. 42. ed., 1800.

^f See also Kopp's "Die Alchemie in alt. u. neu. Zeit," ii, pp. 1—146, on the "Bekanntschaft mit Geheimnissen des Magie, Theosophie, Alchemie u. A."

Even the lower strata of society in England did not escape the contagion. Sir William Temple observes : "I have had several servants far gone in divinity, others in poetry, have known in the families of some friends, a keeper deep in the Rosicrucian mysteries."

There are those who sneer at the attempts of the alchemists to convert the baser metals into gold and are at the pains to insinuate that the motives of the adepts were sordid. It may be that there have been here and there men—vulgar charlatans—who have pursued the art merely from worldly considerations. The high priests of alchemy, however have in every age and clime been honest seekers after truth. Had there been no desire implanted in the human breast to pry into the hidden and occult mysteries of nature there would have been no science. Whence come we and whither are we destined to go? What is this substance made up of, and what are its ultimate constituents, and what will its combination with this or that lead to? These are queries, the solution of which or rather the very attempts to solve which mark the birth of philosophy. Patanjali and Nāgārjuna in India and Paracelsus in Europe stand forth as the prominent representatives of

this spirit of inquiry. They have been dreamers, mystics and naturalists all combined in one. Such geniuses have always chafed at the restraints and limitations imposed on frail man and hence their fervid yearnings to peep into regions beyond the ken of our gross senses. As Emerson puts it :—

"The privilege of this class is an access to the secrets and structure of nature, by some higher method than by experience. In common parlance, what one man is said to learn by experience, a man of extraordinary sagacity is said, without experience, to divine."⁸

Plotinus heaved a sigh at the soul with its infinite possibilities being caged in a frail and corruptible body. The pursuit of alchemy by the esoteric *Tantrist* is easily explained. To him it was only a means to an end. "It (mercury) is alone that can make the body undecaying and immortal."⁹ We find echoes of the same sentiment in the authoritative literature of the Rosicrucians,

Says Waite :—

"Among the concourse of inquirers, and the clamour of supposed and pretended discoverers, there rose gradually into deserved prominence an advanced school of illuminati,

⁸"Swedenborg ; or, the mystic."

⁹ *Vide "History of Hindu Chemistry," Vol. I. Intro.*
Ixxii and xci—xcvi.

who, employing the terminology of the *tertia philosophorum*, under the pretence of alchemical pursuits appear to have concealed a more exalted aim. . . . The student is directed by these writers from the pursuit of material gold to the discovery of incorruptible and purely spiritual treasures. . . Physical transmutation, the one and supreme end of the practical alchemist, sinks into complete insignificance; nevertheless, it is performed by the adept and is a landmark in his sublime program." I. c. p. 32.

The sage and seer of Hoenheim had his wrestlings. Should he pursue knowledge for its own sake or for what it bringeth? His evil genius holds out the bait thus :—

"Know not for knowing's sake
But to become a star to men for ever;
Know for the gain it gets, the praise it brings,
The wonder it inspires, the love it breeds."¹⁰

The spiritual at last triumphs over the base in man. Paracelsus has his revelation, and he bursts forth :—

"Truth is within ourselves : it takes no rise
From outward things, whate'er you may believe,
There is an inmost centre in us all
Where truth abides in fullness : and around
Wall upon wall, the gross flesh bears it in,
The perfect clear perception—which is truth."¹¹

• Browning's "Paracelsus."

In the above delineation the poet has done no more than bare justice to the inward longings of no ideal alchemist, who is only an honest seeker after truth. The spiritual and thought-world has always transgressed all barriers of time and space. Kanāda, Patañjali and Nāgārjuna of India and Heraclitus, Empedocles and Plato and the rest—they all form a holy fraternity ; aye, these prophets and oracles of the intellect belong to a "lofty and sequestered class," "the high-priesthood of the principles of thought from age to age. When at long intervals we turn over their abstruse pages, wonderful seems, the calm and grand air of these few, these great spiritual lords, who have walked in the world,—these of the old religion,—dwelling in a worship which makes the sanctities of Christianity look *parvenues* and popular ; for 'persuasion is in soul, but necessity is in intellect.' "•

• Emerson : on "Intellect."





The metals and their loss in weight after calcination.

Very vague ideas prevailed among the Hindu philosophers on the constitutions of a metal and its fate after calcination. We are reminded of the diversity of opinion in Europe before the time of Lavoisier. A metal like every material substance was supposed to be formed of one or more of the five, bhūtas ; in fact the earthy or saline element was taken to be predominant in it, * and hence it lent itself so readily to calcination. † It should be noted here that by "bhūta" was understood not so much an element in the modern connotation of the term as certain qualities of individual substances. Even mercury was regarded as composed of the five bhūtas. ‡ When a metal was submitted to calcination some of its component bhūtas escaped, leaving the earthy or saline portion behind ; hence the ash (calx) must weigh less than the original metal itself.

* परिवाः तु चर्वतमस्तु तामः विकाशवपापादः । Ch. I., 4. 2
Again in Ch. XLVI (Sūtra) 365 & seq. the metals are included among the saline ingredients.

† Cf. "For some maintain that gold is solid light, or, at least that the chief ingredient is light, which is rendered solid by mixture with some particles of earth. Were it mere earth it might be calcined by fire strongly urged.—Vol. I. P. 9.

‡ पश्चूताम् ८. त्रैश्चिह्नेष उदाहितः । एवं रक्षाच्छ्री ।

There is, however, no direct reference to be met with anywhere as regards the quantitative aspect of the question so clearly established by Lavoisier.

The proportion of loss which a metal undergoes on ignition was made the basis for determining its purity and we find in the law-books an arbitrary scale fixed. Thus according to Yājñavalkya, "gold is unaffected by fire, while one hundred parts by weight of silver, tin and copper lose (lit. undergo decay to the extent of) two, eight and fifteen parts respectively." This is to be taken as referring not to the roasting (killing) of a metal but simply as allowance made to goldsmiths and other artisans for loss incurred in the shape of dross &c. when it is melted in a crucible.

That copper, lead, tin and other base metals (दीक्षातः) when repeatedly calcined are completely reduced to their calces was well known as will be seen throughout the body of the texts. The passage from Rasendra-chūḍamani (p. 14) deserves some notice. Lead of the weight of 30 palas is to be calcined till its weight is reduced to a *karsha* (= $\frac{1}{2}$ pala). Even if it be calcined now one thousand times, it will not undergo further reduction in weight. Our author evidently had his experience of lead derived from argentiferous galena, which would leave

* यदो दुर्बन्धस्त्रीयं विषमं रक्षते असि ।

यदो दुर्बन्ध-स्त्रीयं च तावे पश्चाद्गावसि ॥

a residue in the shape of a "button" of silver after the lead had been cupelled off. •

• Similar confusion prevailed in Europe up till the end of the 17th century. The following extract from Robert Boyle's "Concerning the Unsuccessfulness of Experiments" will make the point clear.

"Having, upon occasion, had the curiosity not long since to visit some mines of lead and other metals, I find that there is a great difference, and discernible even to the eye, betwixt the several ores ; for instance, of lead, some of which I can shew you so like steel, and so unlike common lead-ore ; that the workmen upon that account are pleased to call it steel-ore, which being of more difficult fusion than ordinary, they are wout to mix it with other ore, which they call firm-ore, to facilitate the melting of it. And I likewise took notice of an ore, which for its aptness to vitrify, and serve the potters to glaze their earthen vessels, the miners call pattern-ore, and sell it (at least where I saw it digged up) dearer than other ore, from which it differs both visibly enough, and as the workmen affirm in divers other (and those less obvious) qualities ; and yet all these ores, after fusion, do pass indiscriminately under the name and notion of lead. In which therefore it is no wonder, that severer inquiries find a great deal of disparity. I remember I did not long since cause some lead-ore to be tried, which being the most promising that ever I saw, made me suppose it might contain some considerable quantity of silver : but though it proved as rich in lead, as to yield after the rate of seventy pound to the hundred, yet one of the most expert artists in Europe could not extract one grain of silver out of it ; whereas the lead of very many mines, being skilfully examined, will leave behind it, upon the test, a proportion of pure silver. And though this quantity of silver be not considerable enough to make such mines as yield it pass for silver mines

Antimony.

Although there is no direct recognition of antimony as a distinct metal, some sort of allusion to it as a variety of lead is not wanting. The reason why antimony was often confounded with lead is that at first sight stibnite may be mistaken for galena. The mineral *sauvîrîjana* or *nîlînîjana* was thus indiscriminately applied both to the sulphides of antimony and of lead (cf. vol. I., pp. 93-95). That *nîlînîjana* contained a new metal was often suspected though its nature was not properly understood. Thus in *Rasendra-chûdâmasi* we have "nîlînîjana, mixed with *tikshna* (cast iron), and heated several times yields a superior kind of lead which is readily fusible and is of mild black colour. *

(or, as we are wont to call them mines-royal) because the silver will not quit the cast of extracting it ; yet such mines though they pass but for lead mines with the metallist, may appear to be mixt mines to the naturalist, who may meet with divers experiments, wherein the little silver that is in them, may make their lead operate differently from that of those ores, which are wholly destitute of silver."—Edition of 1772, p. 323.

* *Vide Sans. texts*, p. 52. The identical distich occurs also in R. R. S. Cf. vol. I p. 110. Cf. also "But to detain you no longer on the subject, give me only leave to strengthen the paradox I have proposed, by the authority of that great and candid chymist *Basilius Valentius*, who speaking of antimony, after he hath told us, that there are several kinds of it, and especially two ; the one more mercurial and of a golden property, witnessed by the shining streaks or beams it abounds with ; the

**The preparation known as
Svarnasindura or makaradvaja.**

As the "law of definite proportion" was unknown to the ancients, tedious processes were resorted to for the complete conversion of mercury into its sulphide. "Makaradvaja" even at the present day is a favourite remedy with the Hindu physicians of the A'yurvedic school. Let us follow the recipe as given in Rasendra-chintamani : "when quicksilver is killed with an equal weight of purified sulphur, it becomes hundred times more efficacious ; when it is killed with twice its weight of sulphur it cures leprosy ; when it is killed with thrice its weight of sulphur it cures mental languor ; when it is killed with four times its weight of sulphur it removes grey hair and

other more full of sulphur, but destitute of the golden nature that enriches the former ; add, that there is such a different goodness betwixt the several sorts of antimony, as there is betwixt the several sorts of flesh or fish, which, though agreeing in name and, if you please, in nature, do exceedingly differ in point of goodness, which brings into my mind the great difference which I have found, even visible to the eye, betwixt the several sorts of Antimony."—Boyle's work—I.c. p. 324.

* If we take the historical meaning of the term "A'yurvedic," the above preparation cannot lay claim to this distinction, for it was unknown at the time of the Charaka and the Susruta and was introduced into the *Materia Medica* during the Tantric period.

wrinkles ; when it is killed with five times its weight of sulphur it cures consumption ; and when it is killed with six times its weight of sulphur it is a panacea for all the ills that flesh is heir to.* Now 25 parts by weight of mercury can only take up (i. e. combine with) 4 parts by weight of sulphur ; the excess of sulphur simply sublimes off unchanged. In the actual preparation of *svarnasindura* (Lit. vermillion with gold) the mercury is first made into an amalgam with thin gold leaves and then repeatedly rubbed in a mortar with sulphur. During the process of sublimation (कांपात्वम्) the excess of sulphur volatilises off as we have already explained and the gold in fine particles remains behind as a residue. The lustrous, crystalline, reddish brown sublimate, which collects nearest the source of heat, † has the formula HgS . As there is an erroneous impression about

- गुणे तु यथैः शीर्षे चहास्त्रमुखी रक्तः ।
हिन्दुसे नवदि शीर्षे उच्चंकुड्डरः परः ॥
विनुये यथैः श्रोर्णे सुर्खंजायदिनामामः ।
चतुर्वेद तत्र शीर्षे चक्षीपात्रमामामः ॥
यथे पश्चात्पुर्वे शीर्षे चर्ये चवही चवः ।
पश्चात्पुर्वे यथैः श्रोर्णे सुर्खंरीगहरी रक्तः ॥ ५ ४.

* Gopālakrishna very properly lays particular stress upon this point.

स्थीटविला तु मुम्पादमुहूर्क्षपः शस्त्रं लभेत् ।
पश्चात्पुर्वे रक्षिकृः सुर्खंरोरेतु शीर्षविन् ॥ इति रसेन्द्रवारठंदः ।

the composition of this drug even among educated people in this country we give below the results of analysis of a sample of "mercury killed with six times its weight of sulphur along with gold."*

Identification of metals by their colouration of flames.

Prominent attention should be drawn to the following extract from Rasirnava (Vol. I., p. 68.)

"Copper yields a blue flame • • • • that of the Tin is pignon-coloured ; that of the Lead is pale-tinted"

We are not aware of similar tests being applied anywhere at such an early period as a qualitative test for metals.

The age of Bhikshu Govinda the author of Rasahridaya.

There is a belief current in some parts of the Deccan that our Govinda is no other than the celebrated teacher of Smikaniebhyaya. † If there be any historical foundation for the belief Govinda

* Percentage of sulphur found = 13.89 ; the calculated amount being 18.79 ; not a trace of gold could be detected.

† The following Slokas are cited from Saikaradigvijaya in support of the above :—

तस्मापदायित्वं तवरको मुहावा तारि अपूज्यद्युपेत्व ए इवराहः ।
आपार इमुपदिदिष्ट ए तथ तष्टे बोदिष्टपादगुरुमे न दुष्टं तोषाम् ॥

should no doubt be placed in the 8th century A. D. Apart altogether from the question whether at such an early date the progress of chemical knowledge as revealed in Rasahridaya had been attained in India, the colophon at the end of the work would tell against such an hypothesis (Intro. liii). The author distinctly states that he wrote his book under the auspices of the king of the Kiratas and even throws out a hint that he was of the Buddhist persuasion. We have no valid reasons to believe that Sanikara, the sturdy champion of Brahminical faith and the mighty dialectician, whose activity proved the ruin of Buddhism in India should have sat at the feet of a Guru of the opposite creed.

वाचः पराक्रमस्तः विषय सम्बन्धी तत्त्वाभ्यः यज्ञमुद्दिः विष्णामुक्ताः ।
तत्त्वाभ्यात्मामुपगतः विषय गौडपादी वीर्यद्वापमुनिश्च एव विष्णमृतः ॥
सदाच तत्त्व विष्णटे विषय व्याख्यातः ० ० ० ०

शीर्मध्यवर्तीविष्णवः, १८८३; verses १०१ and १०५-६ ।

बालद्वापमसंकृतयज्ञावादिः—यज्ञाः १३ ।

In the above Slokas Govindanatha Muni is stated to be the preceptor of Sanikara, the former being himself the pupil of Goudapada, who in his turn was a pupil of Sukadeva, son of Vyasa, the well-known compiler of the Vedas. The Govinda natha of the text has been confounded by the commentator, Dhanapati Sūri with the Buddhist Govinda. It is scarcely necessary to take serious notice of the chronological perspective of the author of the Sabkaradigvijaya.

**The Mechanical, Physical and
Chemical Theories of the
Ancient Hindus.**

(By Principal B. N. Seal.)

I propose in this paper to give a synoptic view of the mechanical, physical and chemical theories of the ancient Hindus. A chronological survey, even if the materials for it were available, would be here of little account. The origins of Hindu natural philosophy in the speculations of the Brahmanas and the Upanishads, or in the mythology of the Puranas, however interesting from the standpoint of 'cultur-geschichte,' do not come within the scope of the present exposition, which relates to the result of systematic thought as directed to the phenomena and processes of Nature. I have therefore confined myself to an account of natural philosophy as expounded in the principal systems of Hindu thought. The Sāṅkhya-Pātañjala system accounts for the Universe on principles of cosmic evolution, the Vaisesika-Nyāya lays down the methodology of science, and elaborates the concepts of mechanics, physics and chemistry. The Vedānta, the Pūrva-Mīmāṃsa, and in a less degree, the Baudhā, the Jaina, and the Chārvaka systems, make incidental contributions on points of special interest, but their main value in this regard is critical and negative. The principal authorities

followed in this account, —the Vyāsa Bhāṣya on Patañjali's sūtras, the Saṃhitā of Charaka, the Bhāṣya of Pracastapada, the Varttika of Uddyotakara, and the Viśiṭa Saṃhitā of Varāhamihira,—all centre round the Hindu Renaissance, the beginnings of the anti-Buddhist reaction, in the fourth, fifth and sixth centuries of the Christian era. Whenever I have made use of later authors, e. g. Kumārila, Saṅkara, Śridhara, Viśvanātha, Udayana, Bhāskara, Jayanta, Varvara, Raghunātha, Vijñānabhikshu &c. I have taken care to see (except where the opposite is expressly mentioned) that no idea is surreptitiously introduced which is not explicitly contained in the earlier authors.

The Sāṅkhya-Patañjala System.—This system possesses a unique interest in the history of thought as embodying the earliest clear and comprehensive account of the process of cosmic evolution, viewed not as a mere metaphysical speculation but as a scientific principle based on the conservation, the transformation, and the dissipation of Energy.

Prakṛiti—the ultimate ground:—The manifested world is traced in the Sāṅkhya to an unmanifested ground, Prakṛiti, which is conceived as formless and undifferentiated, limitless and ubiquitous, indestructible and undecaying, ungrounded and uncontrolled, without beginning and without end. But the unity of Prakṛiti is a mere abstraction; it is in reality an undifferentiated

manifold, an indeterminate infinite continuum of infinitesimal Reals. These Reals, termed *Gunas*, may by another abstraction be classed under three heads. (1) *Satva*, the Essence which manifests itself in a phenomenon, and which is characterised by this tendency to manifestation, the Essence, in other words, which serves as the medium for the reflection of Intelligence, (2) *Rajas*, Energy, that which is efficient in a phenomenon, and is characterised by a tendency to do work, or overcome resistance, and (3) *Tamas*, mass or inertia, which counteracts the tendency of *Rajas* to do work, and of *Satva* to conscious manifestation.

The ultimate factors of the Universe, then, are (1) Essence, or intelligence-stuff, (2) Energy, and (3) Matter, characterised by mass or inertia.

These *Gunas* are conceived to be Reals, substantive entities,—not however as self-subsistent or independent entities,—(अवृत्त), but as interdependent moments in every Real or substantive Existence.

Even Energy is substantive in this sense. The infinitesimals of Energy do not possess inertia or gravity, and are not therefore material, but they possess quantum and extensity (परमाण—परिमाण).

The very nature of Energy is to do work, to overcome resistance (रज्जुभूमि उद्देश्यम्), to produce motion. All Energy is therefore ultimately kinetic. Even potential Energy (विकृतिसम्भव) is only the Energy of motion in imperceptible forms.

The original constituents and their interaction. Every phenomenon, it has been explained, consists of a three-fold arché, intelligible Essence, Energy, and Mass. In intimate union these enter into things as essential constitutive factors. The essence of a thing (*sattva*) is that by which it manifests itself to intelligence, and nothing exists without such manifestation in the Universe of Consciousness (*विद्युत्*). But the Essence is only one of three moments. It does not possess mass or gravity, it neither offers resistance, nor does work. Next there is the element of Tamas, mass, inertia, matter-stuff, which offers resistance to motion as well as to conscious reflection. (तमः दृढ़ वरचक्षम्).

But the intelligence-stuff and the matter-stuff cannot do any work, and are devoid of productive activity in themselves. All work comes from Rajas, the principle of Energy, which overcomes the resistance of matter, and supplies even Intelligence with the Energy which it requires for its own work of conscious regulation and adaptation. (चक्रावाणूं वहसाराणीं क्रकार्यप्रवलनमेऽत्रवाहारः सहकारी मयति लीकाचार्य-सम्बन्ध-चिन्तयत्वः)

The Guna^s are always uniting, separating, uniting again. (चक्रोन्मित्याः सर्वं न चाकादिकर्त्तव्याः विशेषा वा उपचर्यते). Everything in the world results from their peculiar arrangement and combination. Varying quantities of Essence, Energy and Mass, in varied groupings, act on one another, and

through their mutual interaction and interdependence evolve from the indefinite or qualitatively indeterminate to the definite or qualitatively determinate. (एते गुणाः परम्परोपरम्पराभिभावाः शोषितादेवसंक्षेपः इतरैतरोपादृष्टव उपाचितमूल्यः ।—भास्माच ।) But though co-operating to produce the world of effects, these divers moments with divers tendencies never coalesce. In the phenomenal product whatever Energy there is is due to the element of Rajas, and Rajas alone ; all matter, resistance, stability is due to Tamas, and all conscious manifestation to Sattva. (परम्पराकाहितेऽपि चलभित्तिभित्तिभावाः—भास्माच । चलभास्मात्तिभित्तिभावः दृष्टिभित्तिभावः इत्यदितीपि इत्ये व्याख्यायः सत्त्वसेव विद्याद्युपः रजस्य विद्युत्युक्तमह एव—विज्ञानभित्ति शोषिताचित्तिभावः इति—नेत्राः इत्यः चक्रोद्धर्मो—वायुभित्तिभित्तिभावार्थो इति भास्माच । ibid—

The nature of the interaction is peculiar. In order that there may be evolution with transformation of Energy, there must be a disturbance of equilibrium, a preponderance of either Energy or Mass-resistance, or Essence over the other moments. The particular Guna which happens to be predominant in any phenomenon, becomes manifest in that phenomenon, and the others become latent, though their presence is inferred by their effect. For example, in any material system at rest, the Mass is patent, the Energy latent, and the conscious manifestation sub-latent. In a moving body, the Rajas, Energy, is predominant (kinetic), while the Mass or rather the Resistance

it offers is overcome. In the volitional consciousness accompanied with movement, the transformation of Energy (or work done by Rajas) goes hand in hand with the predominance of the conscious manifestation, while the matter-stuff or Mass, though latent, is to be inferred from the resistance overcome. (अविद्यायाम् उपदित्तमित्याप्तं तुष्टिष्ठ
० आपारमः तेषां प्राप्तानन्तरामुक्तिविभागः—शास्त्रात्)

The starting point. The starting point in the cosmic history is a condition of equilibrium or equipoise consisting in a uniform diffusion of the Reals. The tendencies to conscious manifestation as well the powers of doing work are exactly counterbalanced by the resistances of the inertia or Mass. The process of cosmic evolution (प्रवृत्ति) is under arrest. (उत्तरवाचसपि शास्त्राद्यक्षा इति :— Pravachana Sutra 61, Chap. I. सामाधारः एव नामतिरिक्तावस्था वस्तुमादिमार्दिन
एव इत्याद्यक्षा एवाचार्यवाच्या इति निष्पत्तिः—विज्ञानधिकृ, ibid).

Beginning of Evolution. The transcendental (non-mechanical) influence of the Purusha (the Absolute) puts an end to this arrest, and initiates the process of creation. Evolution begins with the disturbance of the original equilibrium. How this is mechanically brought about is not very clear. A modern expounder of the Śāṅkhya supposes that the particles of Sattva, Rajas, and Tamas possess a natural affinity for other particles of their own class, and that when the transcendental influence of the Purusha ends the state of arrest, the

affinity comes into play, breaks up the uniform diffusion, and leads to unequal aggregation, and therefore, to the relative preponderance of one or more of the three Gunas over the others. Thus commences formative combination among the Reals, and consequent productive activity. (रूपविद्या वाचकसंक्षेपः व्युत्तिविभावेन व्योर्य उक्तविक्षेपः : Chap. I, Sūtra 66, वदवनमात्र—विभावनिष्ठ । पुष्टिवीजामीना पुष्टिवीजेन वदवनमात्र एव ज्ञातीवदया एषता । व्यावोक्तीपट्टवादिना इदिग्राहादिष्ठ ए तु इति ; ibid., Sūtra 128, Chap. I).

Formation of wholes or systems—collocation of Reals :—Creative transformation accompanied with evolution of motion (परिक्रमा) and work done by Energy (शक्ति) cannot take place without a peculiar collocation of the Reals (Gunas). To form wholes or systems (अमृद्य) it is essential that one Guna should for the moment be preponderant, and the others co-operant. And this cannot be without an unequal aggregation which overthrows the original equilibrium (तुष्टिविद्या, व्युत्तिविभाव),—in other words, without unequal forces or stresses coming into play in different parts of the system. (तुष्टिविद्या—वाचकसंक्षेपः) यात् सक्तिं परिक्रमदवत्.....समुद्देश समवायः । स च गुणान् गुणवत्तान् मापमनन्तरेण न सम्बन्धति । न तुष्टिविभावाची विषयं विद्या । न च वेदव्य-मुपनयोपनिषद्वामावाहते । (वाचकसंक्षेपः, कौमुदी on kārikā 16.)

The Formula of Evolution—Differentiation in Integration.—Evolution (परिक्रमा) in its formal aspect is defined as differentiation in the integrated (उक्तविभाव)

विद्युत). In other words, the process of Evolution consists in the development of the differentiated (विवेद) within the undifferentiated (सामान्यता), of the determinate (विशिष्ट) within the indeterminate (विविद), of the coherent (प्रतिक्रिया) within the incoherent (विप्रतिक्रिया). The evolutionary series is subject to a definite law which it cannot overstep (परिचालनात्मकम्). The order of succession is not from the whole to parts, nor from parts to the whole, — but ever from a relatively less differentiated, less determinate, less coherent whole to a relatively more differentiated, more determinate, more coherent whole. That the process of differentiation evolves out of homogeneity separate or unrelated parts, which are then integrated into a whole, and that this whole again breaks up by fresh differentiation into isolated factors for a subsequent reintegration, and so on *ad infinitum*, is a fundamental misconception of the course of material Evolution. That the antithesis stands over against the thesis, and that the synthesis supervenes and imposes unity *ab extra* on these two independent and mutually hostile moments is the same radical misconception as regards the dialectical form of cosmic development. On the Sankhya view, increasing differentiation proceeds pari passu with increasing integration within the evolving whole, so that by this two-fold process what was an incoherent indeterminate homogeneous whole

evolves into a coherent determinate heterogeneous whole.

The different stadia in the order of cosmic Evolution are characterised as follows :—

- (1) The inconceivable, the unknowable, the formless, of which no character can be predicated (पश्चात्), including Prakriti, or the Real in a state of equilibrium.
- (2) The knowable, the empirical universe, cosmic matter of Experience, things as matter or stuff of consciousness (सत्),—comprising Mahat, the intelligible Essence of the cosmos, evolved by differentiation and integration within the formless, characterless, inconceivable Prakriti.
- (3) Individuated but still indeterminate stuff bifurcating into two series—Subject-experience and Object-experience,—comprising on the one hand the indeterminate unity of apperception or the empirical Ego, as the co-ordinating principle of Subject-series (पञ्जिका), and on the other hand, the indeterminate material potencies, the subtle vehicles of potential Energy (गुणवत्, द्रष्टव्यत), the ultimate subtle constituents of the Object-series (the material world). The previous stadium, the cosmic matter of Experience (सत्, महत्) evolves within itself,

by differentiation and integration, an individuated but still indeterminate stuff in two co-ordinated series, Subject and Object.

- (4) Determinate stuff (विशिष्ट) evolved within the indeterminate by further differentiation and integration, viz., in the series of Subject-experience, sensory and motor stuff ; and in the Object series, a corresponding atomic matter-stuff actualising the material potencies in the form of specific sensible Energies. The latter includes the different classes of Paramāṇus, the different kinds of atomic constituents of different kinds of gross matter (जन्मसूत्र).
- (5) Coherent and integrated matter-stuff, individual substances, characterised by generic and specific properties, which however are not rigidly fixed, but fluent being subject to a three-fold change and constantly evolving, (पुरुषाद्वयदेवद्वयः समृद्धः इत्यनिति एतच्छिः—व्याख्या. Sūtra 44, Chap. III. व्याख्याविविदहमुदाधो इति—व्याख्या, ibid. व्याख्याविविदेवाक्षारं एव दी इति, ibid. इत्येवं पञ्चव्याप्तिव्याप्तिरिक्षाः).
- (6) And so the cosmic series moves on in ascending stages of unstable equilibrium (विश्वरूपरिक्षाम्) until the reverse course of equilibration and dissipation of Energy

(वायुपरिवाह and वायुवाया) which even now constantly accompanies the evolution and transformation of Energy, completes the disintegration of the universe into its original unmanifested ground, the unknowable Prakriti.

The order of Cosmic Evolution according to the वायुभाष्य (Sūtra 19, Pāda II) is shown below, in a tabular form :—

Prakriti, the unmanifested unknowable ground
(पृथग्भूतमविद्या)

Cosmic matter of experience (अवृत् विद्या)

Subject series (विद्येय)	Object series
I individuated indeterminate mind-stuff (unity of apperception empirical Ego, विज्ञाता)	I individuated determinate matter-stuff (subtile material potencies, सत्त्वात्)

Determinate mind-stuff (विद्येय)	Determinate matter-stuff (विद्येय) atomic and molecular constituents of gross matter (परमाणु—सूक्ष्मूत्र)
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Coherent and integrated matter-stuff (चतुरस्तिवाचय उभृतः उहातः इष्य)

Individual substances, with generic and specific characters subject to constant change or evolution e.g. inorganic objects composed of atoms or molecules (परमाणु), vegetable organisms (इष्य), animal organisms (अरीर) (चतुरस्तिवाचयः उहातः अरीरे इष्यः परमाणुरिति—वास्तवा, Sūtra 44, Pāda III).

तत् तत् संकर्षणिष्यते व्याकाराद्भूतेः, तत्त्वा एविदेशाः विहाने
संकरा विषिष्यन्ते, परिचाकामनिवाप्त, तत्त्वा तेऽप्यविद्यु भूतेन्द्रियादि
पंखानि विषिष्यन्ते, न विदेशेषः पर तत्त्वाकरमति तेषाम् भूतेन्द्रिया-
द्वापरिचामा व्याकाराद्भूतेः (व्याकारा, Sūtra 19, Pāda II).

N.B.—The usual order given in the Sāṅkhyā compendiums is as follows :—Prakṛiti, Mabat, Ahaṅkāra,—and then the bifurcation, *e.g.*, 11 organs sensory, motor and common sensori-motor from Rajasic Ahaṅkāra, and Tanmātras from Tāmasic Ahaṅkāra,—and finally the Paramāṇus of the Sthūla-Bhūtas.

The conservation of Energy (and of Mass)—the transformation of Energy :—

The Gunas (Reals), though assuming an infinite diversity of forms and powers, can neither be created

nor destroyed. The totality of the Mass (Tamas), as well as of Energy (Rajas) remains constant, if we take account both of the manifested and the unmanifested, the actual and the potential. But the individual products of the evolutionary process, the concrete phenomenal modes resulting from the combined action of the original Mass, Energy and Essence, are subject to addition and subtraction, growth and decay, which are only due to changes of collocation, and consequent changes of state from the potential to the actual, (in other words, from the future to the present and from the present to the past, in a time series)—changes, which are illusorily ascribed to the Reals themselves. The different collocations of Mass and Energy give birth to the divers powers of things, the various forms of Energy which may be classed as like and unlike; indeed the course of Evolution from the Reals conforms to a fixed law, not only as regards the order of succession, but also as regards the appearance (and mutual relations) of like and unlike Energies. And this transformation is constantly going on,—the course of Evolution is not arrested for a moment.

मुक्तात् सर्वेषांकानुपातिः य इत्यत्तदसे नीयत्राद्यने अतिथिरेष
करोताऽवावत्प्रवावस्थावस्थातीतिः त्रुष्टात्प्रविभौभिः उपज्ञापाववर्च्छा इत्य
प्रवावस्थास्यने (शास्त्रात्, Sūtra 19, Pāda II). परिष्वानिनिष्वाता
त्रुष्टाम् । सर्वेषांदि मुक्तात् सर्वित्वेष्विष्वावावात् (ibid. Sūtra
13, Pāda IV). एते त्रुष्टाः त्रुष्टात्प्रवावत्प्रवातीयवर्जित्वेष्विष्वात् (शास्त्रात्,
(ibid., Sūtra 19, Pāda II). परिष्वानिनिष्वात् (शास्त्रात्,

Sūtra 19, Pāda II). अतावत् परिवासात्मके देतु. (*Patañjali* Sūtra 15, Pāda III). प्रसिद्धि: परिवासशीला चक्रमयपरिक्रमा वाचिष्ठैः ।

The doctrine of Causation, a corollary from the conservation and transformation of Energy :—the principle of collocation—the storing-up and the liberation of Energy :—

The Sāṅkhyā view of causation follows at once as a corollary from this doctrine of the conservation and transformation of Energy. As the total Energy remains the same, while the world is constantly evolving, cause and effect are only more or less evolved forms of the same ultimate Energy. The sum of effects exists in the sum of causes in a potential (or un-evolved) form. The grouping or collocation alone changes, and this brings on the manifestation of the latent powers of the Ganas but without creation of anything new. What is called the (material) cause or sum of material causes is only the power which is efficient in the production or rather the vehicle of the power. This power is the unmanifested (or potential) form of the Energy set free (व्युत्पत्ति) in the effect. But the concomitant conditions are necessary to call forth the so-called material cause into activity. When the favourable combination or co-operation of concomitants is wanting, there is no manifestation of the effect. The question is—what is the aid which the concomitant conditions render to the deter-

mination (and production) of the effect existing in potency in its material cause ? First there is the merely mechanical view as illustrated by some commonplace examples, e.g., the manifestation of the figure of the statue in the marble block by the causal efficiency of the sculptor's art, or of the oil in the sesamum by pressing, or of the grain of rice out of the paddy by the process of husking. In these cases the manifestation of an effect is only its passage from potentiality to actuality, a stadium in the process of evolution from possible (future) existence to actual (present) existence ; and the concomitant condition (वहकारित्व) or efficient cause (विनियोगारण), the sculptor's chiselling, the pressing, the husking, is a sort of mechanical or instrumental help to this passage or transition. कार्यक्रियमत्तमेव उपादान-कारकव्यम् । का अः कार्यम् वनामतावदा एव । स एव विशेषः (उपनेः शास्त्र कारणं विशेषः) वज्ञानः कार्यक्रिय वनामतावदा इत्यतो (विज्ञानमित्र-प्रबन्धमात्रम्, Sutra 115, Chap. I). चक्रिकः वर्णनामतावदा । कारदद्वापारीष्टप कार्यम् वर्णनामवच्छपरिवामेव अनुष्ठाति । ददा विज्ञानमध्यक्षस्तिवावदा; चेहित-व्यापारिष्ट चक्रिकिमां तिक्ष्णतेऽस्य च विद्योक्तेन उत्पत्त्वात्पूर्वक च अवशालेन (विज्ञानमित्र-प्रबन्धमात्रम्, Sutra 129, Chap. I).

These mechanical examples of the Kapila-Sāṅkhya have the merit of simplicity, but the Patañjali-Sāṅkhya brushes them aside, and explains causation on the basis of the conservation and transformation of Energy, advancing it as the liberation of potential Energy existing

stored up in a Guna collocation, (the sum of material causes) the liberation following on the action of the proximate efficient cause, or concomitant condition (किञ्चित्कारण) .

The causal operation of concomitant conditions (efficient causes) lies only in this that they supply a physical stimulus which liberates the potential Energy stored-up in a given collocation. Everything in the phenomenal world is but a special collocation of the ultimate Reals (Energy, Mass and Essence). The sum of (material) causes potentially contains the Energy manifested in the sum of effects ; and in the passage from potency to actualisation, the effectuating condition (the concomitant cause) when it is itself accomplished, is only a step in the evolutionary series, which adds a specific stimulus, and renders determinate that which was previously indeterminate. When the effectuating condition is added to the sum of material conditions, in a given collocation, all that happens is that a stimulus is imparted, which removes the arrest, disturbs the relatively stable equilibrium, and brings on a liberation of Energy (ज्ञातर्गति) together with a fresh collocation (कुप्रसिद्धिविदेव). उच्चनिद मृषाणा कल्पितविदेवमात्र इति परमाणुं युक्तामात्रः (व्याख्यात्मा, Sôtra 13, Pâda IV, सतत् पदान् निमित्ते वहन्मात्रीवर्थं सम्बोधयूक्तविदेव)। मिहू निमित्ते विनियोगविदेवामुद्देश्यति (व्याख्यात्मा, Sôtra 12, Pâda IV).

Describing the production of bodies ('organic vehicles') for individual souls, out of matter of Prakriti, under the influence of their merit and demerit, as concomitant conditions, Patañjali points out that non-material concomitants like merit and demerit do not supply any moving force or Energy to the sum of material conditions, but only remove the arrest (the state of relatively stable equilibrium) in a given collocation, even as the owner of a field removes the barrier in flooding his field from a reservoir of water. This description is intended to represent the super-physical influence of non-material concomitants (or causes) like volition, merit and demerit, etc., but the causal operation of a material concomitant condition is essentially the same;—there is the same reservoir of stored-up Energy in a given collocation,—the same condition of arrest or relatively stable equilibrium,—the same liberation of the stored-up potential Energy which flows along the line of least resistance;—the only difference being that in the case of material concomitants the stimulus which removes the arrest is physical, instead of being transcendental as in the case of non-material causes like will, merit and demerit, etc.

The Vyāsa-bhāṣya helps us to a clear mental representation of the details of this process, being perhaps the finest example before Newton of the exercise of a Scientific Imagination, and as memor-

able as any in the whole history of thought containing as it does the theory of potentials as in a nutshell :—As the owner of many fields can irrigate, from a field which is already flooded, others of the same or a lower level, without forcing the waters thereto with his hands, and merely by making an opening in the barrier or dyke, on which the waters rush in by their own force ;—or farther, as the same person cannot force these waters, or the earthy matters held in solution therein, into the roots of the rice plants, but only removes the obstructive grasses and weeds, on which the fluids of their own power enter the roots ;—such is the action of an effectuating condition (विनियोग) added to a sum of material causes or conditions.

पतंजलि चार्चोदर्थं इहसीना दर्शयेद्यत्तु ततः सेपिक्षवत् (Patañjali Sutra 3, Páda IV). ए फि चक्रादि विनियोग का विकलः उदारात् च पूर्ववात् विद्युत् प्रसारविद् ; तस्म नियोग का विकल वा वापः प्रविलापवर्त्तता चावरच तु चाक्षो भिन्नता तत्त्वविद् भिन्ने सदमिवापः उदारात्म चात्रवदविनि ।

Chain of Causation—fixed order.—The order of Evolution with the transformation of the Energies follows a definite law. The unalterable chain of causes and effects in the phenomenal world illustrates this fixed order. But though the cosmic order is one and fixed, it comprehends divers series arising from different combinations of the original Gunas, which constitute subordinate or particular laws of cause and effect (समावरणं परिवासावते उत्तुः, Patañjali Sútra 15, Páda III).

What we call the qualities of things are only modes of Energy acting in those collocations. वीमहायस्त्रा चक्षेः प्रतिरूपे चक्षः—त च कलासुभेदानुभितस्त्रात् (व्याख्या, Sūtra 14, Pāda III). ते उल्लिखी चक्षों वर्णमात्रा व्याख्यातः, चक्षोत्तात्त्रावतः एवाचाप्तः सम्बिदं द्रुकात् वर्णसंबन्धावभिति परमांशो वृद्धामात् (व्याख्या, Sūtra 3, Pāda IV). And these various Energies are sometimes actual (kinetic), sometimes potential, rising to actuality, and sometimes sublatent, subsiding from actuality into sublatency. In fact, the original Energy is one and ubiquitous, and everything therefore exists in everything else, *potentialiter* (उच्चं दर्शनाभिति), without prejudice to the generic and specific differences of things (व्याकुलेदेव उच्चं दर्शनाभिति). Inorganic matter, vegetable organisms, and animal organisms are essentially and ultimately one (अस्तुष्टोऽपारिकामिकं रसादिदेव इति तत्त्वा व्यावरात् वहमेव व्यामात्रा व्याप्तिरूप) so far as Mass and Energy are concerned, but the varied forms of Energy and the generic and specific qualities (or properties) of things, which are but modes of Energy, follow a definite unalterable law in the order of their appearance and succession, under conditions of space, time, mode and causality, and hence all effects do not manifest themselves at once द्विष्टात्त्राकारनिमित्तापरम्यात् त उत्तु उमामात्रावत् व्यामात्राविभिति: (ibid, Sūtra 14, Pāda III). ती उत्तु उपर्युक्त मन्त्रमात्री इत्यः स तत्त्वात् तमः। पितृः प्रचक्षते चट उपज्ञायने इति उपर्युपरम्यात् तमः। उत्तुपारिकामन्त्रमः चटस्य उपज्ञायनात् वर्णमात्रा व्याप्तिरूपः। तत्त्वा पितृस्य उपज्ञायनामात् चक्षोव्याप्तिरूपः (व्याख्या, Sūtra 15, Pāda III).

Time, Space, and the Causal series :—

A Tanmatra (infra-atomic particle of subtle matter) is conceived by our understanding to stand in three relations—(1) position in Space (स्थानसम्बन्ध), (2) position in the Time-series (कालावधिसम्बन्ध) and (3) position in the causal series (विभिन्नावधिसम्बन्ध).

These three relations are the work of the intuitive stage of knowledge as opposed to the conceptual (विकल्पसम्बन्ध) as opposed to अविकल्पसम्बन्ध. But this is not the pure relationless intuition of Reality (विज्ञान विकल्पसम्बन्ध) which may be termed intellectual intuition, but the intuition that imposes its forms on the Real substrate (अविकल्प सिद्धिकल्पसम्बन्ध) or in other words empirical intuition. तत्र मृतदेहे च विकल्पवर्णं देहाऽविभिन्नावृप्तावस्थां वा कलापर्णः सा अविकल्पा व्युत्पन्नीः। तत्त्वापि पश्चात्तद्विकल्पावस्थां उद्देश्यवर्णितं मृतदेहावृप्तीभूतं समाधिष्ठायामुपतिष्ठते (आहारा, Sôtra 43, Pâda I).

Infinite Time is a non-entity objectively considered, being only a construction of the Understanding (विज्ञानाव) based on the relation of antecedence and sequence in which the members of the phenomenal series are intuited to stand to one another. These phenomenal changes as intuited by us in the empirical consciousness fall into a series, which the Understanding conceives, as order in Time. The Time-series, then, is a schema of the Understanding for

representing the course of Evolution. The schema of the Understanding supervenes on the phenomenal world as order in time, and hence in the empirical consciousness the Time-series appears to have an objective reality, and to form a continuum. As there is an ultimate and irreducible unit of extensive quantity (*वस्तुता*) in the Ganas or infinitesimal Reals of Prakriti, which are without constituent parts, so the moment may be conceived as the ultimate and irreducible unit of this time-continuum as represented in the empirical consciousness. A moment therefore cannot be thought of as containing any parts standing in the relation of antecedence and sequence. If change is represented by the Time-series, a moment as the unit of time may be supposed to represent the unit of change. Now all physical change may be reduced to the motion of atoms in Space, and we may therefore define the moment as representing the ultimate unit of such change — viz., the (instantaneous) transit of an atom (or rather a Tanmātra) from one point in Space to the next succeeding point. Even an atom has constituent parts (the Tanmātras), and hence an atom must take more than one moment to change its position. The motion of that which is absolutely simple and without parts from one point in Space to the next must be instantaneous, and conceived as the absolute unit of change.

(and therefore of time, वर्ष). If this is held to be an irreducible absolute unit, it will follow that what we represent as the time-continuum is really discrete. Time is of one dimension. Two moments cannot co-exist. Neither does any series of moments exist in reality. Order in Time is nothing but the relation of antecedence and sequence, between the moment that is, and the moment that went just before. But only one moment, the present, exists. The future and the past have no meaning apart from potential and sublatent phenomena. One kind of transformation, to which a thing is subject, is that it changes from the potential to the actual, and from the actual to the sublatent. This may be called the change of mark (वर्णपरिवाप) as opposed to change of quality (रूपपरिवाप), and the change due to duration or lapse of time (वर्षपरिवाप). The present is the mark of actuality,—the future, the mark of potentiality,—and the past, of sublatency,—in a phenomenon. Only one single moment is actual, and the whole Universe evolves in that one single moment. The rest is but potential or sublatent.

चक्रतनुसारीवर्णसंक्षिप्त वस्तुमाहार इति बुद्धिसमाजार्थः मुहूर्तादीरणादादः ।
म स्वर्गये वाचः वस्तुएवो बुद्धिवर्णादः वर्णदण्डानुपातो लीकिदामा
द्युग्मितदद्वेषाना वस्तुस्वरूप इव चरमास्त्रम् । चरम्भु वस्तुपतितनुसारीवस्तुमी ।
स्वर्गवस्त्रामनक्षम्याक्षम् । ते वाचदिदः वाच इति चाचक्षते लीकिमः । न च
हो चक्षी मह भवतः, वाचत न ह वदीः उद्भुवोरवस्त्रात् पूर्वकादुपरकाविनो
वदामन्त्रे चरम्भु व वस्त्रः । तस्मात् वस्त्रमात् एवेषः चन् न पर्वीन्दरवस्त्रः ।

सत्त्वीति वाचाकात्तु तद्वादितः । ये तु ग्रन्थादिः चक्षाः मे परिकामादिका
व्याख्याताः । तेऽप्येति चक्षेन इत्यका लोकः परिकामसम्बुद्धति, तद्वादाहादः
व्यक्तवी चक्षाः । यद्युपचर्यं पर्यन्तं इत्य् परमाचारः एव परमापचर्यं पर्यन्तः
चाचः चक्षः । यादतः वा समयेन चक्षितः परमाचारः पूर्णदेशं अस्तान्
उत्तरदेशम् उपचर्यक्षेत च चाचः चक्षः, तत्प्रवाहादिक्षेदग्ने चक्षः । (ग्रन्थाद
Sutra 52, Pada III.)

Vijnâna-bhikshu points out that this does not amount to a denial of Time. It means that time has no real (or objective) existence apart from the 'moment'. But the latter is real, being identical with the unit of change in phenomena (ग्रन्थपरिकामस चक्ष-व्यक्तात्). But even this is real only for our empirical (relative) consciousness (अनुभूतदर्शन), which intuits the relation of antecedence and sequence into the evolving Reals (Gunas), in the stage of 'empirical intuition' (अविचारा निर्मितव्यवस्था). The 'intellectual intuition' (निर्मितचारा निर्मितव्यवस्था) on the other hand, apprehends the Reals as they are, without the empirical imported relations of Space, Time and Causality.

Space as extension and Space as position :—

Space must be distinguished as Deea (locus, or rather extension) and Dik (relative position). Space (Dik) as the totality of position, or as an order of co-existent points, is wholly relative to the Understanding, like order in time, being constructed on the basis of relations of position intuited by our empirical (or relative) consciousness. But there is this difference between Space-order and Time-order :—there is no unit of Space as position (Dik),

though we may conceive a unit of Time, viz., the moment (चक्रः) regarded as the unit of change in the phenomenal or causal series (परमात्मिका or गुणपरिवारका चक्रवर्त्तनाम्—शोदशांश्च, Sutra 51, Pada III). Spatial position (Dik) results only from the different relations in which the all-pervasive Akâsa stands to the various finite (or bounded) objects. On the other hand, Space as extension or locus of a finite body, Desa (देशः जित्यापादः), has an ultimate unit, being analysable into the infinitesimal extensive quantity inherent in the Reals (Gunas) of Prakriti. (गुणपत्रैरस्तपरिवारः—शोदशांश्चः एतम् जित्या दिवयि चानांश्चको व्याप्तात्, वासावतो हिमज्वरहारामावान् पूर्वाद्यवर्षः यस्माद् दिग्गुणाधिमित्रैष चक्रवान् कामावतः वातदिव्यवहारस्त्वेऽपि चाकाशाद्य तदुपपत्तेषु। चाकाशं हिमवं पिण्डेषु वर्तु वाचः चक्रप इति, दिक् तु संख्यैष मैत्रैते।

The Casual series.—The relation of Cause and Effect has been already explained. It only remains to add that the category of causality is mediated through the schema of order in Time. The Empirical Intuition first superimposes relations of antecedence and sequence on changing phenomena (the evolving Gunas or Reals), and the Understanding out of these relations creates order in Time. The Empirical Intuition then intuits the phenomenal series of transformations of Energy in this Time-order and in so doing, imports the relation of cause and effect into the course of Nature. (चार्यवारप्रकाशदीक्षा चक्रवर्त्तनाम्—शोदशांश्च, Sutra 51, Pada III).

The dissipation of Energy (and of Mass)—their dissolution into the formless Prakrti:—Cosmic Evolution (परिवाप्ति) is a two-fold process, creative as well as destructive, dis-similative as well as assimilative, katabolic as well as anabolic (प्रदूषोन्नति and प्रशोधन्ति). In one aspect, there is the aggregation (unequal aggregation) of Mass and Energy, with consequent transformation of Energy, resulting in the creation of inorganic as well as organic matter, and the genesis of worlds. The successive steps of this process may be described as (1) unequal aggregation with storing-up of Energy in a certain collocation, under a state of arrest (i. e., in a state of relatively stable equilibrium), (2) a stimulus removing the arrest, and disturbing the equilibrium, and (3) liberation of the Energy, moving on to a fresh collocation, fresh aggregation, arrest and equilibrium. The process of the world thus moves on from equilibrium to equilibrium, and the result of that process is the development of a coherent determinate heterogeneous whole (सत्त्व विद्युत् विद्युत्, व्यक्तिभूद्यवस्था, व्यक्तिभूद्यवस्था) in what is essentially an incoherent indeterminate homogeneous whole (वाता).

But there is a second aspect of this evolutionary process. Unequal aggregations are unstable, there is a constant tendency in things to go back to the original stable equilibrium,

the state of uniform equal diffusion of Reals. This process is called the resolution of like to like (उपरिकाम), consisting in assimilation and dissipation, and being the exact opposite of the process of "differentiation in the integrated" which has evolved the Cosmos. The collocations of Mass, Energy and Essence are always breaking up, and the Energy as well as the Mass, however slowly, however imperceptibly, are being dissipated, i. e., dissolved into the original formless Prakrti, a state of permanent equilibrium and arrest, from which there is and can be no return, except under the transcendental influence of the Absolute at the commencement of a new creative cycle. Not that there is a destruction of the Mass or Energy, but a dissipation or dissolution into a condition of equal uniform diffusion from which there is no return. This is not the phenomenon of kinetic Energy disappearing and becoming potential or sublatent, for in such cases there is restitution or reconversion by natural means. When this reverse current of assimilation (and dissipation) prevails over the current of dissimilation (and integration), the Universe will disintegrate more and more, until it disappears in the formless Prakrti, its unknowable source and ground (तत्त्व एवं शौमुदी).

The Evolution of matter (वायविक वृत्ति) :—

The ultimate constitution of Matter is a question of the profoundest interest in the Sankhya-Patañ-

jala system. Three stages clearly stand out in the genesis of Matter :—(1) the original infinitesimal units of Mass or inertia, absolutely homogeneous and ubiquitous, on which Energy does work, when the original equilibrium comes to an end (भूतादि—प्रसारादार). (2) The infra-atomic unit potentials, charged with different kinds of Energy, which result from the action of Energy on the original units of Mass, (प्रकाश), and (3) the five different classes of atoms, the minutest divisions of which gross matter is capable, but which are themselves complex Tanmatric systems (तन्मत्रपरमाणु) .

The first stadium Bhūtādi is absolutely homogeneous and absolutely inert, being devoid of all physical and chemical characters (व्यापित्तिरक्षयुत) except quantum or mass (परिमित , परिमाण); and this admits neither of addition nor of subtraction, can neither be created nor destroyed. The second stadium Tanmatra represents subtle matter, vibratory, impinging, radiant, etc., instinct with potential energy. These potentials arise from the unequal aggregation of the original mass-units in different proportions and collocations with an unequal distribution of the original Energy (Rajas). (सर्वादि इति कारणता इति चेत् व्यापारव्याप्ताः युक्तादिवद्वादिव व्यवीक्षण इति संबोधितेष्व एव—ज्ञानोद्दीपदात्मादिवा इति इति इति च युक्तः ।) The Tanmatras possess something more than quantum of Mass and Energy. They possess physical - characters, some of them penetrability

(वरकारदात), others powers of impact or pressure, others radiant heat, others again capability of viscous and cohesive attraction. In intimate relation to these physical characters they also possess the potentials of the energies represented by sound, touch, colour, taste and smell, but being subtle matter they are devoid of the peculiar forms (फॉर्म) which these potentials assume in particles of gross matter like the atoms and their aggregates. In other words, the potentials lodged in subtle matter must undergo peculiar transformations by new groupings or collocations to be classed among sensory stimuli,—gross matter being supposed to be matter endowed with properties of the class of sensory stimuli, though in the minutest particles thereof the sensory stimuli may be infra-sensible (चलोन्द्र बत न चलुहत). (तांत्रिक तत्त्वादः स च विदेविषः । स च परावः आवश्यरमुडावः स्वरूपत-
वदादिविषेः यस्मा एषष्टप्राप्तः । तत्त्वा च तान्त्रिकेष्ट्वद्विवद्वद्व-
वस्त्रमेव मूलानि वदादितत्त्वादत्यः ।)

The Tannatras, then, are infra atomic particles charged with specific potential energies,—first, the potential of the sound stimulus is lodged in one class of particles, Tannatras which possess the physical energy of vibration (परिवर्ण) and serve to form the radicle of the other atom (आवश्यरमाप्त), then the potential of the tactile stimulus is lodged in another class of Tannatras, particles which possess the physical

energy of impact or mechanical pressure in addition to that of vibration and serve to form the radicle of the gas atom (*Vāyu Parmanu*) ;—next, the potential of the colour stimulus is lodged in a third class of Tanmātras, particles which are charged with the energy of radiant heat and light in addition to those of impact and vibration and serve to form the nucleus of the light and heat corpuscle ; then the potential of the taste-stimulus is lodged in other Tanmātras, particles which possess the energy of viscous attraction, in addition to those of heat, impact and vibration, and which afterwards develop into the atom of water, and lastly, the potential of the smell-stimulus is lodged in a further class of Tamātras, particles which are charged with the energy of cohesive attraction, in addition to those of viscous attraction, heat, impact and vibration and which serve to form the radicle of the earth-atom.

सहस्रावः तद्यति इष्टतन्त्रां विश्वामित्रं उपतन्त्रां रक्षतन्त्रां
वस्तुतन्त्रां च तद्यति इष्टतन्त्रां विश्वामित्राः । व्यासम्—
Sutra 19 Padam II विश्वामित्रं इष्टतन्त्रां रक्षतन्त्रां उपतन्त्रां
वस्तुतन्त्रां च तद्यति इष्टतन्त्रां विश्वामित्राः । एवं तद्यति इष्टतन्त्रां
वस्तुतन्त्रां च तद्यति इष्टतन्त्रां विश्वामित्राः (व्यासम्—Sutra 62, Chap. I).

प्रदादीना स्तुतिमावकानीयानाम एवः परिकामः पूष्टिशेषमात्रः
सम्पादितव्यः । सुताकर्त्तुं च विलोक्य अप्यामित्वा द्विकावदामाति उपादाय
कामात्मम उक्तिकारात्मः समाप्तिः । (कामभाष. Sutra 14.
Padा IV.) तत्परा । गम्भीरतात्मक वस्त्रयित्वा चतुर्थप्राप्तात्मा ऐहशास्त्रीयात्मा

एवं परिकामः अस्तपरमात्मः तेषां च महात्मादिः, एवं अस्तरमौ वज्रदिवा
सौभग्यानीवानां विश्वकाराणां तेजोऽप्तः तेषां महात्मादिः । एवं
अस्तरमुडपाणी वज्रनाम वायुषः तेषां महावायुदिः । एवं अस्तरमात्मा-
इहाराम्बस्तुताम वाकात्मामः तेषां महात्मादिः ।

विज्ञानविषय remarks :—एवं इति च ये विद्याः अस्तादि-
तमात्मपाणी वाटिवलेष्टदिवात्माः पूर्वोत्तादिप्रात्माः सति । (वौवार्णीय,
Sutra 14, Pada IV.)

Before explaining the genesis of atoms, it is necessary to say something about Akāsa, which is the link between the infra-atomic particles (Tanmātras), and atoms (Paramāṇus). Akāsa corresponds, in some respects to the ether of the physicists and in others to what may be called proto-atom (protyle). In one respect Akāsa is all-pervasive (विस्त), and devoid of the property of impenetrability which characterises even the infra-atomic potential units (Tanmātras). In another aspect, Akāsa is described as having originated out of the mass or inertia in Prakriti (Bhūtādi) when the latter became charged with the fire potential vibration (the sound-potential). Vijnāna-bhikṣu in the Yoga-Vārtika boldly tackles the difficulty. Akāsa, he explains, has two forms, original and derivative non-atomic and atomic. The original Akāsa is the undifferentiated formless Tamas (mass in Prakriti, matter-rudiment—Bhūtādi) which is devoid of all potentials, and is merely the all-pervasive seat or vehicle of the ubiquitous original Energy (Rajas). This Akāsa

must not be confounded with vacuum, which is merely negative (वाक्षात्मा—un-occupiedness), though it must be conceived as all pervasive, occupying the same space as the various forms of gross matter (समानदीर्घकम्—पदचापसहपद् वाक्षात्—त्रिगतान्तिः). and therefore devoid of the property of impenetrability (मूर्त्तिरासमानदीर्घते—त्रिगतान्तिः) which characterises atomic matter. But when the original equilibrium (वाक्षात्मा) comes to an end, unequal aggregations form collocations in different groups and proportions of the three Gunas (त्रिगतिक्षमादेव वाक्षीयं संयोगविभेदः संज्ञन—{त्रिगतिक्षम, त्रिगतान्ति and त्रिगतान्तिः}). The transformation of Energy now begins,—working on a collocation of mass (with Essence) (त्रिगतात्मीय-संज्ञन महावतः—विकाशित, त्रिगतान्तिः); it first gives rise to the sound potential (संज्ञनश्चात्मीयादेव परिवर्तन—विकाशित) and the atomic Akāra (proto-atom, protyle) is but an integration of the original unit of mass charged with this vibration potential. This vibratory (or rather rotary) ether-atom (वाक्षात्मा) is integrated, limited (परिवर्तन) and as such cannot occupy the same space with other (subsequently integrated) atoms. But this proto-atomic integration of Akāra (वाक्षात्मा) is formed everywhere, and itself residing in the ubiquitous non-atomic Akāra (वाक्षात्मा—पदचापसहपद् वाक्षात्) forms the universal medium in which air or gas atoms, light and heat corpuscles, and other atoms move and float about. (वाक्षीयादः; वहि हि पदचापसहपद् वाक्षात्)

म काम तदा मृत्युंजये चारादिष्ट वक्तव्यादित्रीयो न वाप—
विज्ञानधिक्, शोदशार्थिः Sutra 40, Pada III. चारादि च
चार्यादारवस्तुपेक्ष दिविषमः । तत् चारादाराऽप्य तमीन्दुष्विज्ञेयतयेव
चर्युत्तिवर्तीः । तदानीष चारादाराऽप्युच्चलव्यादिवृक्षिवेक्षामात् । तत्
चारादाराऽप्य व्याकरणवद् संदर्भः चादी अस्त्रमन्त्योग्याद्युपेक्ष परिक्षमनि
ततय उपस्थृतेन पुष्टिवृद्धिं सहायताकामः । एहादारपेक्षा परिष्ठः
वाचीरादारवद् उपर्याप्ति (विज्ञानधिक्, शोदशार्थिः, Sutra 41, Pada III).

The genesis of the infra-atomic unit-potentials (Tanmātras) and of the atoms.

The subject of the genesis and the structure of the Tanmātras and the Paramāṇus was a fascinating one to these ancient thinkers, and a wide divergence of views prevailed. I will here notice several typical views :—those of the Vishnu Purāṇa, Parāśara, Patañjali and a certain School of Vedāntists reported in the ऋग्वेदपाठ.

1. A famous passage in the Vishnu Purāṇa explains the genesis and the structure of the Tanmātras and of the Bhūtas (Paramāṇus) in the following manner :—

The first Tanmātra originated from the rudiment-matter (Bhūtādi), the individuated but still indeterminate potential-less Mass in Prakṛiti under the action of Energy (ऊर्ध्वरूपः परिक्षमन्तः—उर्ध्वरूपात्, Sutra 68, Ch. I.) by a process of disintegration and emanation (विकृचितः—विवृतात्—० विवृतारात्—व्याप्तिः, Sutra 14, Pada IV. विवृताभावः विकृचिताभावी व्याप्तिः । इति

वायुम्, वोदयसिंह on *Patañjali's Sutra*.—मनीषिणि' विकरणमात्रः etc.) in the menstruum, or surrounding medium of the unindividuated Cosmic Mass (Mahat) (महतात्मा :).

This first subtle matter, the first result of 'Mass disintegration' and Energy-transformation, is charged with the sound-potential, the potential of vibration or oscillation (प्रक्षिप्त). It is called the sound-potential (प्रक्षिप्तमात्रा).

This is typical of the genesis (and structure) of the other Tanmátras (kinds of subtle matter). In each of the remaining cases, an atomic Mass charged with actual specific energies (मूलपरमाणु) disintegrates and emanates, and thus evolves a form of subtle matter (a kind of Tanmátra) under the action of Energy, and always in the same menstruum or surrounding medium,—that of Bhútádi, the super-subtle. Each kind of subtle matter becomes charged with a new potential in addition to the potentials already evolved. The genesis of an atom, Bhúta-Paramánu, is a quite different process. Here the unit potential (Tanmátra) receives an accretion of Mass, and by a sort of condensation and collocation evolves an atom (Bhúta-Paramánu).

The genesis and structure of the Tanmátras and the Bhúta-Paramánius are worked out below :—

1. The super-subtle individuated Mass (rudiment-matter (Bhútádi), under the action of the

original Energy (रूपः) disintegrates and emanates (विसर्पते) in the menstruum or surrounding medium (सुमात्रा) of Mahat, cosmic super-subtile Mass, and evolves a form of subtle matter (तन्मात्रा), which becomes charged with the sound-potential (vibration-potential, परिवर्णः), and is called the unit of sound-potential (प्रधनमात्रा).

2. This subtle matter, the Mass, charged with sound-potential, receives an accretion of Mass from the rudiment matter (Bhūtādi) and by condensation and collocation evolves the A'kāsa Bhūta, the atomic A'kāsa, the proto-atom charged with the specific energy of the sound stimulus (actual vibratory motion.) (एष यत्किं ब्रह्म-तन्मात्रात् विद्युत्काम् आकाशं उदयः । तदा एष बहुरग्न्यतन्मात्राभास्ति विद्युता आकाशं स्वयं ।—वीर्यात्मिक on the Vishnu Purāna passage, Sutra 14, Pada IV).
3. This proto-atom, the atomic A'kāsa, charged with its actual specific energy, again disintegrates and emanates, under the action of the original Energy, and in the menstruum of the rudiment-matter (super-subtile Mass) and thus evolves another kind of subtle matter (Tanmātra) which becomes charged with the touch-potential (the potential of impact or mechanical pressure

(प्रकाश-प्रभावीत्व) in addition to the sound-potential (vibration-potential—प्रवर्त्यता) and is called the unit of touch-potential (प्रकृतिप्रकाश).

4. Next, this subtle matter, the mass charged with touch (and sound) potential, i.e., with the potentials of vibration and impact, receives an accretion of mass again from the rudiment-matter (Bhūtādi) and by condensation and collocation, evolves the Vāyu Bhūta, a kind of gaseous matter or air of which the atoms are charged with the actual specific energy of the touch stimulus, i.e., with actual energy of impact in addition to the actual energy of vibratory motion.
5. Next, the atom of Vāyu, so charged with the actual specific energy of impact and vibration, again disintegrates and emanates, under the action of the original Energy, and in the same menstruum or surrounding medium of the rudiment matter (super-subtile Mass—Bhūtādi) and thus evolves another kind of subtle matter (Tāmmátra), which becomes charged with the heat-potential (षट्—षट्—heat-and-light potential) in addition to the impact-potential and the vibration-potential, and is called the unit of colour-potential (प्रकृतिप्रकाशःषट्).

6. Now this subtle matter, this radiant matter, charged with light-and-heat-potential, and also with impact and vibration-potential, receives an accretion of Mass again from the rudiment-matter (Bhūtādi), and by condensation and collocation evolves the Tejas Bhūta, the light-and-heat-corpuscle, which is charged with the specific Energy of the colour-stimulus, i.e. radiates actual heat and light (sabda) in addition to manifesting the energy of impact (impingency) and of vibration (or oscillation).
7. Next, this atom or light-and-heat-corpuscle disintegrates, and emanates as before a form of subtle matter charged with the taste-potential (रसात्मा), in addition to the three potentials already generated, and also with the physical potential of viscous attraction.
8. This subtle matter charged with the taste-potential and with the potential of viscous attraction condenses and collocates as before into the water-atom which manifests the actual specific energies of viscous attraction and the taste-stimulus.
9. The viscous water-atom charged with the actual specific Energy of the taste stimulus disintegrates, and emanates as before a form of subtle matter charged with the

smell-potential in addition to the four potentials already generated and also with the potential of cohesive attraction.

10. This subtle matter charged with the smell-potential and with the potential of cohesive attraction condenses and collocates as before into the earth-atom, which manifests the actual specific Energies of cohesive attraction and the smell-stimulus.

Vijñāna bhikṣu in the Yoga-Vārtika briefly summarises the Vishnu Purāna process as follows :—

Bhūtādi as radicle in conjunction with Mahat produces the sound potential, which as radicle in conjunction with Bhūtādi produces Ā'kāsa, which as radicle in conjunction with Bhūtādi produces the touch-potential, which as radicle in conjunction with Bhūtādi produces Vāyu, which as radicle in conjunction with Bhūtādi produces the colour-potential, which as radicle in conjunction with Bhūtādi produces Tejas and so on.

In this brief summary he does not bring out the force of विद्युतः (the disintegrating process), and the distinction between the genesis of subtle and gross matter (Tānamātra and Bhūta).

वायु व्रष्टादेव नहात्, महता उ तद्वातः ।
भूतादिष्टु विद्युतादः समे तन्मातिकं ततः ।

सुरः प्रदत्तवाऽन् वाक्यं प्रदत्तवाऽन् ।
 प्रदत्तवाऽन् तदाकां भूतादि च विमानोन् ।
 वाक्यावत् विकृत्यादि अर्थमात्रं सुरः च ।
 वाक्यावत् विमानं वायुः तत्र अर्थो गुणो मतः । (विष्णुराष्ट्र)

11. A famous passage in Parâsara takes another view of the genesis and structure of the Tanmâtras and the Bhûta-l'aramânas. Krishnapâda, in the तत्त्वविवरण, represents the scheme as follows :—

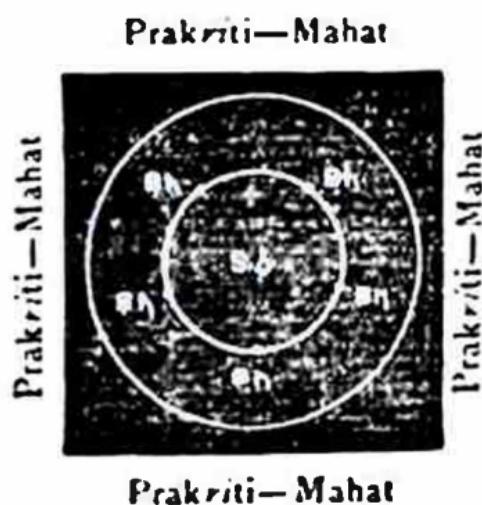
The Tanmâtras originate from one another in one linear series, and each Bhûta originates in a separate line from its own Tanmâtra.—

भूतादि (Bhûtâdi)

प्रदत्तवाऽन्	Sound-Tanmâtra—as a radicle or centre surrounded or encircled by Bhûtâdi generates Akâsa.
अर्थत्वाऽन्	Touch-Tanmâtra—as a radicle or centre encircled by Sound-Tanmâtra with Akâsa-atom as a help generates Vâyu—
कल्पत्वाऽन्	Colour-Tanmâtra—as a radicle or centre encircled by Touch-Tanmâtra with Vâyu-atom as a help generates Tejas—
रसत्वाऽन्	Taste-Tanmâtra—as a radicle or centre encircled by Colour Tanmâtra with Tejas-atom as a help generates Ap—
वास्तवाऽन्	Smell-Tanmâtra—as a radicle or centre encircled by Taste-Tanmâtra with Ap-atom as a help generates Prithivi.

The genesis of a Bhūta-Paramánu (atom) from the subtle matter of a Tanmátra is not here so simple as in the view of the Vishnu Purana. The latter speaks of condensation and collocation, but in the passage under reference a Tanmátra is supposed to act as a radicle, as the centre of a system, surrounded or encircled by Tanmátras of the immediately higher order in the medium of its own Bhúta.

Thus an atom of A'kásh has the following structure :—

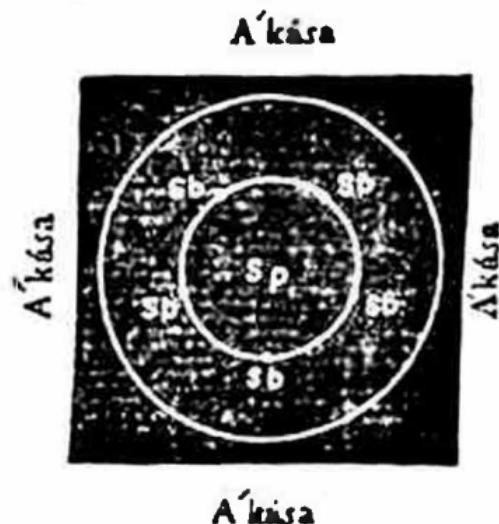


An atom of A'kásh

Sb = S'abda-Tanmátra (vibration-potential)

Bh = (Bhútádi)

An atom of Vāyu is constituted as follows :—
 This takes place within the surrounding medium of A'kāsa.

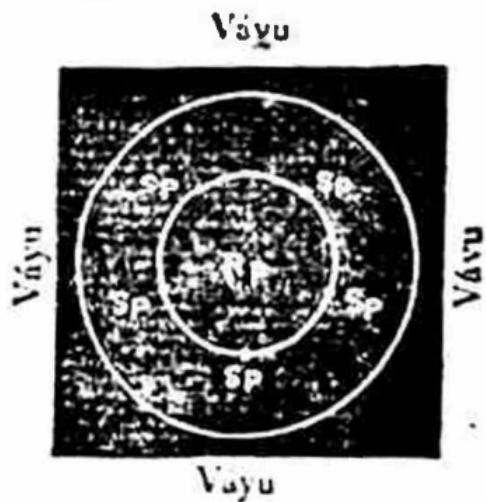


An atom of Vāyu

Sp = Sparsea-Tanmātra (impact-potential)

Sb = S'abda-Tanmātra (vibration-potential)

An atom of Tejas—heat-and-light corpuscle—
 has the following structure :—



An atom of Tejas

Rp = Rupa-Tanmatra (light-potential)

Sp = Sparsa-Tanmatra (impact-potential)

and so on.

A Chemist will be disposed to push his chemical processes into the region of subtle matter. He may translate वायु as a menstruum, and विद्युत् as a catalytic agent. In this case, an atom of Vāyu will be considered as generated from the impact-Tanmātra as a radicle, in the menstruum of vibration-Tanmātra, with Akasa-atoms as a catalytic agent.

प्रकारं जनः—मूलादिः प्रदत्तमाव॑ जावते, प्रदत्तमाव॑ मूलादिरात्रीति,
ततः प्रकार॑ जावते, ततः प्रकार॑ प्रदत्तमा॒ चात् अर्बंतमाव॑ जावते, प्रकार॑
तमाव॑ प्रदत्तमाव॑ लाभोति, एवं प्रदत्तमाव॑ जावता॒ चाकाव॑ उहाव॑ कान्
अर्बंतमाव॑ यामुखाव॑ जावते, ततः प्रकार॑ अर्बंतमाव॑ उपतमाव॑ जावते
उपतमाव॑ अर्बंतमाव॑ लाभोति, एवं अर्बंतमा॒ चाहता॒ यामुख॑ उहाव॑ कान्
उपतमाव॑ तेशी जावते—*and so on.* **प्रकारं जनः** तत्त्वदर्शिवरै
ज्ञात्पादेष्वः। परवरमुच्चि, तत्त्वदर्शिमात् (*संविष्टकरण*).

A slight variation of the above view is ascribed to a certain school of Vedāntists in the तत्त्वविद्यपाद.

The scheme may be represented as follows :—

A Bhûta-atom is evolved by integration (condensation and collocation, भूतात्पाद) from the corresponding Tanmâtra (subtile matter). This is the same view as that of the Vishnu purâna.

The Tanmâtras again evolve from one another in a lineal series as in Pârisara's view. But the process of this generation is somewhat more complex. A Tanmâtra first disintegrates and emanates in a surrounding medium (a menstruum) of the Tanmâtra just preceding it in the order of genesis and with the help of its own Sthûla Bhûta as a sort of catalytic, generates the Tanmâtra next in order : e.g., the infra-atomic impact particles (अन्तरात्मा) disintegrate or emanate, in a surrounding 'atmosphere' of the vibratory subtile matter (विद्युतभूमि) and then with the help of their own atomic integration Viyu, gas, generate the Tanmâtra next in order, the subtile matter of radiant light-and-heat (रूपः).

III. Patañjali's view, as expounded in the व्याख्यान and शोक्यार्थिक is as follows :—

(a) The order of genesis of various forms of subtile matter (potentials) :—

(1) Bhûtâdi, the rudiment-matter, original Mass, acted on by Rajas, Energy, produces the sound-potential (vibration-potential) व्याख्यान वहुरात्मा वहस्तयमी राजदाहार सहस्रार्थी वरति ।

(2) This subtile vibration-potential, as a radicle, with accretion of rudiment-matter

(Bhútádi) condensing and collocating, and acted on by Rajas, generates the subtle touch-potential (impact-potential) which is impingent as well as vibratory (oscillating).

- (3) This subtle impact-potential again, as a radicle, with accretion of rudiment-matter (Bhútádi) condensing and collocating, and acted on by Rajas, generates the subtle light-and-heat potential (*tejotma*) which radiates light-and-heat, in addition to being impingent and vibratory.
- (4) Next, the light-and-heat potential, as a radicle, with accretion of rudiment-matter, (Bhútádi) condensing and collocating as before, generates the subtle taste-potential, which is charged with the potential of the taste-energy, and of viscous attraction, in addition to being vibratory, impingent and radiant.
- (5) Lastly, the subtle taste potential as a radicle, with accretion of rudiment-matter as before, condensing and collocating, generates the subtle smell-potential, which is charged with the potential of the smell-energy, and also of cohesive attraction, in addition to being vibratory, impingent and radiant.

The order of genesis of the Bhūta Paramāṇus (forms of atomic matter).

The five classes of atoms are generated as follows :—

- (1) The sound-potential, subtle matter, with accretion of rudiment-matter (Bhūtādi) generates the A'kāsa-atom.
- (2) The touch-potentials combine with the vibratory particles (sound-potential) to generate the Vāyu-atom.
- (3) The light-and-heat potentials combine with touch-potentials and sound-potentials (i.e. with impact particles and vibratory particles) to produce the Tejas-atom.
- (4) The taste-potentials combine with light-and-heat potentials, touch-potentials and sound-potentials (i.e. with radiant, impinging and vibratory particles) to generate the Ap-atom and
- (5) The smell-potentials combine with the preceding potentials (i.e. with particles of taste-energy and with radiant, impinging and vibratory particles) to generate the earth-atom.

The A'kāsa-atom possesses penetrability, the Vāyu-atom impact or mechanical pressure, the Tejas-atom, radiant heat-and light, the Ap-atom, viscous attraction, and the Earth-atom, cohesive attraction.

Vijñāna-bhikshu in one passage gives the following scheme of the genesis of the Bhūtas :—

A radicle of sound-potential with rudiment-matter gives A'kāsa-atom (Bhūtādi), a radicle of touch-potential with A'kāsa-atom gives Vāyu-atom, a radicle of light-and-heat potential with Vāyu-atom gives Tejas-atom, a radicle of taste-potential with Tejas-atom gives Ap-atom, and a radicle of smell-potentials with Ap-atom gives Earth atom. On this view, an atom

of A'kāsa = Bh(Sb)

of Vāyu = { Bh(Sb) } (Sp)

of Tejas = { Bh(Sb) } (Sp) Rp

where Bh = भूतादि, ' Sb = स्वरूपादि, Sp = अवृत्तप्राप्ति, Rp = रुद्रप्राप्ति, and so on.

Bhūtas and Paramāṇus—Cosmo-genesis and its successive stages.

The 'five Bhūtas' stand for a classification of substances on the basis of their generic properties resulting, as the Sāṅkhyas hold, from the structural type of their constituent atoms—a classification more physical than chemical, or properly speaking chemico-physical, unlike the purely chemical classification of the so-called elements of modern chemistry. A Paramāṇu, again, is a type of atoms corresponding to each Bhūta class, and indeed one and the same kind of Paramāṇu may comprehend atoms

of different masses, if only these should agree in their structural type.

Cosmo-genesis—a bird's eye view :—Out of the all-pervasive rudiment-matter (Bhūtādi) appeared A'kṣa (ether), first as a Tanmātra (subtile matter) charged with the potential energy of sound (vibration-potential), and then as an atomic integration of a mono-Tanmātric structure (the A'kṣa-atom — आक्षायक) also ubiquitous and all-enveloping. In the next stage we find a new kind of Tanmātras, systems of the infra-atomic vibratory particles, so arranged as to manifest a new form of energy, that of impact or mechanical pressure and these Tanmātras (विकरुर्पत्र) combining with the vibration-potentials (A'kṣa Tanmātra) produced a new kind of atom, the di-Tanmātric Vāyu-atom, which by aggregation formed a gaseous envelope composed of impinging (driving) vibratory particles (Vāyu). Next appeared the third class of Tanmātras, infra-atomic systems of the impinging vibratory particles, which by their collocation developed a new form of Energy—the energy of radiant heat-and-light. These Tanmātras (तेजस्त्रिमित्र) combining with the potentials (Tanmātras) of vibration and impact, produced a new kind of atom—the tri-Tanmātric Tejas-atom, the light-and-heat corpuscle, which by aggregation enveloped the gaseous world in huge flames. In the next stage we have the fourth class of

Tanmātras, new and complex infra-atomic systems of the radiant impinging vibratory particles, which evolved the energy of viscous attraction as well as the potential Energy concerned in the taste-stimulus. These Tanmātras (तन्मात्राः) combining with the three previous ones, gave rise to another class of atoms, the tetra-Tanmātric Ap-atom, and the flaming gases were thus precipitated into cosmic masses of viscous fluid matters (Ap). Finally appeared the fifth class of Tanmātras infra-atomic systems of the viscous radiant impinging vibratory particles which developed new forms of Energy—the Energy of cohesive attraction, as well as the potential energy concerned in the stimulus of smell. These Tanmātras (तन्मात्राः) uniting with the other four kinds of infra-atomic subtle particles, formed another class of atoms, the penta-Tanmātric Earth-atom. Thus the viscous fluid matters were condensed and transformed into the Earth-Bhūta, comprising the majority of the so-called elements of chemistry.

The Purāṇas, in their own fanciful way, conceive that, in the course of cosmic evolution, each succeeding Bhūta appeared within an outer envelope of its immediate predecessor, with a total mass (or volume ?) a tenth less than that of the latter.

विष्णु तत्त्वावेद देवतास्ती वायुः प्रकृतिः ।
 विष्णवैत् वडिनप्तेऽनदती वायुवर्जितः ॥
 वायुकाशरवेदं वा वृत्तार्थिक-विचारणा ।
 वायीर्द्वायामतो व्युमी वडिर्यो व्रकृतिः ॥
 वृत्तावीर्ण तारतम्य वायुवैभूतपवदै ॥

(पद्मावती-मूर्तिविक, slokas 72, 81 and 82)

Examples of the different Bhūtas :—

1. Akāsa :— This is ubiquitous.
2. Vāyu :— Various substances composed of di-Tanmātric atoms,—kinds of Vāyu—must have been formed in the gaseous envelope in the second stage of cosmic evolution, out of the proto-atoms of Akāsa. But they have either suffered a fresh transformation into substances of a more complex atomic structure, or have dissipated into the mono-Tanmātric Akāsa, out of which they took their rise. The one familiar example now surviving is atmospheric air. Water-vapour (वाष्प) is but water (Ap), and smoke, fumes, etc. but earth-particles in gaseous diffusion.
3. Tejas .— Various classes of Tejas corpuscles,—substances with tri-Tanmātric atomic structure, i.e. two grades subtler .

than the ordinary elements of chemistry (which are of a penta-Tanmátric structure),—are even now known. (तेजो भौतिकी-भैश्य वस्तुवाचः । और हित वैदिक वाचवर्ण—वरदरम्भाच,—सत्त्ववस्थाच) :

First, there is fire, or the light-and-heat emitted by the burning log of wood or lamp (अग्निः—दीपः—भौतिकं तेजः). Now it is important to note that the flame of a burning log of wood (इन्द्रिय) or an oil-lamp is not pure Tejas, a pure mass of light-and-heat corpuscles. There is chemical union with Earth-particles (particles of the hard penta-Tanmátric substance) acted on by Energy; and then the Tejas corpuscles, light-and-heat particles which are latent (absorbed) therein, come forth as flame (पाञ्चिंशोपदेशं तदत्पत्तात् तेजः अस्तिमवति—विज्ञानमित्य—वरदरम्भाच. Sútra 110, Chap. V). Then there is the light of the sun and the stars (हित और वादिकाच) which are flaming masses of molten viscous matters (अस्त्रादेशं तेजः हित एव स्फूर्तिः—वस्त्ववस्थाच, अस्तिमवर्ण) or of molten earthy matters स्फूर्तिः संस्थापि तेजाचि पादिवद्वय-सहर्षेच वरहिताचि,—विज्ञानमित्य, वस्त्ववस्थाच, Sútra. 13, Chap. III). There is also the lightning, which liberates a kind of Tejas latent in the aqueous particles and vapours, under the action of

Energy, in the same way as an ordinary fire liberates the Tejas latent in the wood or other fuel. Next there are the stores of animal heat derived from the break-up of the nutritive material (जीवदेह). Lastly there comes the peculiar form of the Tejas Energy (radiant Energy) stored up in the metalliferous ores and igneous rocks which have been formed in the subterranean heat. Here Earthy matters are mixed up, but the radiant Energy predominates in the composition of the metals (मित्रादिक्षेम नेत्रादिता सुरक्षादोष—विज्ञानिक, परमाणुमाण, Sūtra 19, Chap. III). Aniruddha, a late Sāṅkhya commentator, notes in reference to 'igneous bodies' that the greater part of their mass is derived from the Earth-Bhūta, though the Tejas particles determine the peculiar chemical combination, which produces them; and this must also be his view of the composition of the metals. यथा चरि (तेजसे वरीरे चरि) यज्ञरपार्विषायवायदद्यन्तम्, वस्त्रे
कासुरगोकात् । (विज्ञानिक—Sūtra 112, Chap. V.)

4. Ap. This viscous fluid of a tetra-Tanmatric structure has but one pure example, viz., water, though the various organic acids, the juices of fruits and the sap of plants, are supposed to be transformations of watery radicles combined with different kinds of earthy accretions.

5. Lastly the Earth-Bhûta, the hard full-formed matter, with its penta-Tanmâtric atoms, comprises by far the majority of the so-called chemical elements.

The question is,—how does one and the same Bhûta, of the same formal structure, comprise different kinds of elements, with different atomic masses, and different characteristic properties? And the answer is not far to seek. The properties of a thing are only the energies that are manifested in the particular collocations of the three Gunas.—Mass, Energy and Essence; and a tri-Tanmâtric, or a penta-Tanmâtric atom, i.e. an atom composed of three or of five kinds of Tanmâtras may differ from another of the same class, in respect of the number of constituent Tanmâtras of any particular kind, as also of their collocation or grouping, and therefore in mass as well as in generic and specific characters.

The Sâṅkhya-Patañjala conceives the properties (or energies) of substances to result from the grouping or the quanta of the Tanmâtras, or the Gunas themselves, and hence any radical differences in substances of the same Bhûta class must characterise their atoms, though in an insensible form. In the Nyâya-Vaisesika, on the other hand, the atoms of the same Bhûta class are alike in themselves, homogeneous; and the

variety of substances comprehended under the same Bhūta, is ascribed merely to the different arrangements or groupings of the atoms (अवृत्तिः) and not of their components, for components they have none.

As a typical and familiar instance of the variety of characteristic properties (or energies) that may result from variations in accompaniment or grouping, the Sāṅkhyā-Pātañjala points to the various kinds of fruit acids and juices, all originating from one and the same Bhūta (water) with different accretions of earthy matters (मूर्यकाराः). In the same way, though we speak of only five classes of Tanmātras and atoms, the infinite variety of the world results from the infinitely varied collocations of the three original Guṇas, which underlie Tanmātra and atom alike (समरप्रसादापादः चेष्टाः परमाचरिता—ज्ञानात्मिक, उद्योगात्म, reporting the Sāṅkhyā view : चतुर्विद्यावयः चेष्टाः परमाचरिता—ज्ञानात्म, Sūtra 44, Pada III.—परमाणः ज्ञानात्मविद्येषामा चतुर्विद्यावदमेदानुमतः उमुदाय.—ज्ञानात्म, Sūtra 44, Pada IV,—शोभ्यतावच्छापा चर्चितः ब्रह्मित्वं चक्षः (ibid., Sūtra 14, Pada III.) ये एव्यु चतुर्विद्यातीता ज्ञानात्म-विद्येषामा शीघ्राती चर्ची (ibid., Sūtra 14, Pada III).

ज्ञानात्म—वचं एष्वपादी तुलाती चनेकदण ग्रहिः—
इवत् ज्ञान वरिकामतः सक्षित्यत्। वजा ज्ञानात्मविमुक्तं उद्योगं
एवरक्षं चपि वजा॒विद्याराय् ज्ञानात्म ज्ञानित्व-तात्त्वी-विज-

विरचित्-विन्दुकालवद्-विप्रियाकरणतत्त्वा विरचामात् अनुराक्षसवय-
तिष्ठप्तुष्टावत्त्वा विचलते, एवमेवैक्यनुष्टुप्यात् प्रधानं गुणम् वाचित्
वाचानगुणः परिचामभेदात् प्रवर्भवति । उदिदमुत्त्रं प्रविशत्तिनुवाचव-
विविष्टात्, एकोहगुणात्तदेव यो विश्वलक्षणात् इत्येति ।

(वाचवति—बोगुडी—On Kārikā 16.)

If we take a unit of rudiment-matter (Bhūtādi) for the unit of mass (cf. the mass of an electron with a charge of motion etc.), and represent the first Tanmātra by t_1 such units, and if further, t_2 , t_3 , t_4 , t_5 units of mass (Bhūtādi) be successively added at each accretion to form a fresh Tanmātra, then the second, third, fourth and fifth Tanmātras will respectively contain $t_1 + t_2$, $t_1 + t_2 + t_3$, $t_1 + t_2 + t_3 + t_4$, and $t_1 + t_2 + t_3 + t_4 + t_5$ units of mass.

Also the Vāyo atom (bi-Tanmātric system) will contain $t_1 + (t_1 + t_2)$, i.e. $2t_1 + t_2$ units of mass ; the Tejas-atom (tri-Tanmātric system) will contain $t_1 + (t_1 + t_2) + (t_1 + t_2 + t_3)$ i.e. $3t_1 + 2t_2 + t_3$ units ; the Ap-atom (tetra-Tanmātric system) $t_1 + (t_1 + t_2) + (t_1 + t_2 + t_3) + (t_1 + t_2 + t_3 + t_4)$, i.e. $4t_1 + 3t_2 + 2t_3 + t_4$ units ; and the Earth-atom (penta-Tanmātric system), $t_1 + (t_1 + t_2) + \dots + (t_1 + t_2 + t_3 + t_4 + t_5)$, i.e. $5t_1 + 4t_2 + 3t_3 + 2t_4 + t_5$ units.

If t units of mass be added to the first Tanmātra to form the atom of Akāsa, the latter will contain $t_1 + t$ units of mass.

In other words the numbers representing the mass-units (Tamas) in the different classes of atoms (gross matter) will form an ascending series, viz. $t_1 + t_1$, $2t_1 + t_1$, $3t_1 + 2t_1 + t_1$, $4t_1 + 3t_1 + 2t_1 + t_1$, and $5t_1 + 4t_1 + 3t_1 + 2t_1 + t_1$.

Now if a follower of the Śāṅkhya-Pātañjala were asked to account for differences among Paramāṇus of the same Bhūta class, he would perhaps suppose t_1 to vary from α_1 to β_1 , t_2 from α_2 to β_2 , t_3 from α_3 to β_3 , t_4 from α_4 to β_4 , and t_5 from α_5 to β_5 .

Therefore the mass-units contained in the Vāyu-atoms of the different possible Vāyu substances would be represented by $2\alpha_1 + t_1$, $2\alpha_1 + 1 + t_1$, $2\alpha_1 + 2 + t_1$, $2\beta_1 + t_1$, in A. P. with unity as common difference, there being $2(\beta_1 - \alpha_1) + 1$ possible Vāyu substances.

The mass-units contained in the Tejas-atoms of the different possible Tejas substances would be represented by the series, $3\alpha_3 + 2\alpha_3 + \alpha_3$, $3\alpha_3 + 2\alpha_3 + \alpha_3 + 1$, $3\beta_3 + 2\beta_3 + \beta_3$, increasing in A. P. by unity as common difference, there being $3(\beta_3 - \alpha_3) + 2(\beta_3 - \alpha_3) + (\beta_3 - \alpha_3) + 1$, Tejas substances possible.

The mass-units contained in the Ap-atoms of the different possible Ap-substances would form the series $4\alpha_1 + 3\alpha_1 + 2\alpha_1 + \alpha_1$, $4\alpha_1 + 3\alpha_1 + 2\alpha_1 + \alpha_1 + 1$, $4\beta_1 + 3\beta_1 + 2\beta_1 + \beta_1$, there being $4(\beta_1 - \alpha_1) + 3(\beta_1 - \alpha_1) + 2(\beta_1 - \alpha_1) + (\beta_1 - \alpha_1) + 1$ Ap-substances possible.

The mass-units contained in the Earth-atoms of the different possible Earth-substances would form the series in A. P., $5\epsilon_1 + 4\epsilon_2 + 3\epsilon_3 + 2\epsilon_4 + \epsilon_5$, $5\epsilon_1 + 4\epsilon_2 + 3\epsilon_3 + 2\epsilon_4 + \epsilon_5 + 1$,..... $5\alpha_1 + 4\alpha_2 + 3\alpha_3 + 2\alpha_4 + \alpha_5$, there being $5(\alpha_1 - \epsilon_1) + 4(\epsilon_2 - \epsilon_1) + 3(\alpha_3 - \epsilon_3) + 2(\alpha_4 - \epsilon_4) + (\alpha_5 - \epsilon_5) + 1$ Earth-substances possible.

Size (परमाणु).—As to size or volume, the Sāṅkhya accepts only two kinds,—the infinitesimal, which is also without parts (पूर्ण—निरांश) and the non-infinitesimal, which consists of parts (अपूर्ण—कांशक). The latter varies from the excessively small (the so-called Aṇus, Tanmatras and Paramāṇus) to the indefinitely great (परमात्मा—e.g.—Akāśa).

The Gunas alone are infinitesimal, with the exception of those ubiquitous ones that evolve into Akāśa-atoms and Mind-stuff (आकाशाणु and वस्त्राणु);—all the rest of the evolved products (whether subtle or gross matter) are non-infinitesimal.

Vijñānabhikṣu notes that all the Gunas (Reals) cannot be ubiquitous. If this were the case, that disturbance of equilibrium, that unequal aggregation with unequal stress and strain, with which cosmic evolution begins, would be impossible. The Gunas, which give rise to Akāśa and Mind-stuff, must be held to be ubiquitous, and this will suffice for the ubiquity of Prakṛiti,

(त च एवद्वये युक्ताकाराभूमिः विभूतिमेषाद्यव्यती इति वाचन् । एवमः वर्ताकारहेतुयुक्ताना विभूतेन तदुपयतोः । सर्वयुक्ताना विभूते यति चादपरिकामहेतुयुक्तोभसंबोधाद्यसंभवात् (वीदवार्त्तिक, Sūtra 61, Pada III.)

Chemical analysis and Synthesis—Elements and Compounds.

What then is the equivalent in the Sāṅkhya-Patañjala of the distinction between a chemical element and a chemical compound, or is there none? Did or did not this elaborate physical analysis and classification of things lead on to a classification based on chemical analysis and chemical synthesis? These are questions of singular interest, the answer to which will disclose some new points of view from which the ancient Hindu thinkers approached the problems of chemical physics and physical chemistry.

Aggregates (अमृषाः) may, in regard to their structure, be divided into two classes, (1) those of which the parts are in intimate union and fusion, being lost in the whole (अयुतसिद्धाद्यवाः अमृषाः) ; and (2) mechanical aggregates, or collocations of distinct and independent parts (युतसिद्धाद्यवाः अमृषाः).

A substance is an aggregate of the former kind, and may be divided into two classes, (1) the Bhutas and their 'isomeric' modifications अत, अत्तिक and अत्तिकार) ; and (2) chemical compounds (विभित्तिक).

स्वरूपादेः). Chemical compounds again may be subdivided into two classes, (1) those composed of atoms of the same Bhūta class, i.e. of different isomeric modifications of the same Bhūta, and (2) those composed of atoms of different Bhūta classes. In the first case, there is contact between 'isomeric' atoms (उभातोद्युधीय), in the second case, between heterogeneous or 'polymeric' ? atoms (विभातीय-संयोगीय). The first contact leads to intimate union (उपादानः—सहायः एव संयोगविद्येयः निर्मित इत्यादा विकारी अवस्था—विभातीयिषु प्रवर्तनाद्य) : the isomeric atoms by a peculiar liberation of Energy (उभातोद्योपदात्र—*the action of similars on similars*) are attracted towards one another, and being riveted as it were, form the so-called material cause (उपादान कारण) of the compound product. The second kind of contact (that between unlike or 'polymeric' ? atoms of heterogeneous Bhūtas) begins with a liberation of Energy (उपदात्र), which breaks up each of the Bhūtas, and taking particles (or atoms) of one as nuclei or radicles groups particles of the rest round these radicles in a comparatively free or unattached condition. In this case, one Bhūta, that which serves to furnish the radicles, not necessarily that which is numerically or quantitatively predominant, gets the name of material cause (उपादानकारण), and the others, which by their collocation cause the liberation of Energy (उपदात्र, उपदात्र or विद्येय).

are called efficient causes (विभिन्न चारक) — परमेष्ठैव-
पुच्छत्वात् प्रसादं वृच्छाविश्वं च वाक्यात् परिवालभेदात्
प्रवर्त्तनि—पाचस्ति, कोमुदी on Kārika 16. The illustration given (viz. the Basas as modifications of Ap, water, with Earth-accretions) show that this process applies not only to the Gunas, but also to the Bhūtas. वदा आकाशादिकरणं सतिं परितं आवाहयात्
संत्रेषाम् भिष्टे—(कोमुदी on Kārikā 17).—तद चपि (सेत्रम्
ज्ञरीरै चपि) वहुतश्चार्दिशादवकावद्यात् ४५८८ च वग्रप्रभेदात् (चनिद्रा
on Sūtra 112, Chap. V), आतिशाद्यं च वाक्याद्योदत्तात्
आवृहमवधाते चलेत्तरपि इन्द्रियैः एकदा प्रवृच्छुत्पादये वाचं नाशं
(विज्ञानभिषु—प्रवृच्छुत्पाद) .

Aniruddha goes so far as to hold that both 'isomeric' and 'polymeric' (or 'heterogenic') combinations are real cases of constitutive contact, (चारकलहंडीग, e.g. औतिकवाकीद्वारकवातम्—चनिद्रा on Sūtra 113, Chap. V.) But in the later Saṅkhyā-Pātañjala the current teaching denied this—वह्यामुपादानाकीर्तात् (Sūtra 102, Chap. V), when विज्ञानभिषु notes—वह्यो
मित्राकालोदानो चोपादानम् न हृष्टविति सज्जातीष्मियोपादानम् । इतरथं
वृक्षशुद्धवसुप्रस्तुतम् ।

But besides these transformations of substance (इत्याकर-परिवाल) by 'isomeric' or 'heterogenic' process, ceaseless changes go on in the characters, the modality, and the states of substances—changes

which are due to the unequal distribution of force (or of stress and strain,—pressure) among the Gunas, which are in themselves constant. (चर्चा वस्त्रापरिकामः १३ हस्तालकाः—यदा पदः इवा इत्यादे इति देहस्तामि देहं एव चेष्टामि, यदा चेष्टामि चोमि दुहिता च यसा चति,—गुणिनामेऽपि मुकामा विमर्शेत्याग्न—आत्माम्, Sutra 13, Pada III.)

"Even as the same figure '1' stands for a hundred in the place of hundred, for ten in the place of ten, and for a unit in the place of unit."

* This conclusively proves that the decimal notation was familiar to the Hindus when the Vyāsa-Bhāshya was written, i.e. centuries before the first appearance of the notation in the writings of the Arabs or the Greco-Syrian intermediaries. Vāchaspati, who comments on the Vyāsa-Bhāshya, composed his Nyāya-Sūchī-Nibandha in साहस्राब्दी i.e. Samvat 898 or 812 A. D. This cannot be S'aka 898, for apart from the decisive use of अष्ट, which by this time had come to signify the Samvat era, Vāchaspati's commentator Udayana, wrote the Lakshāsāras in S'aka 906—

न व्याज्ञारात्परिमितेन्द्रिये भक्ताभ्यः ।
वदेद्यनवले तु योपां वचवायत्तीम् ॥

and Udayana, who wrote the Parisuddhi on the Tātparyatikā of Vāchaspati, could not have been a contemporary of the latter, as will also appear from the invocation to Sarasvati in the opening lines of the Parisuddhi. Vāchaspati then preceded Udayana by 142 years, and must have been himself preceded by the author of the Vyāsa-Bhāshya by a

Now the question is—in these mixed substances does the fusion take place by Paramāṇus or by larger masses (or lumps) ? Now a Paramāṇu is defined to be the smallest portion of any substance which exhibits the characteristic qualities of that substance,—in other words, it stands for the smallest homogeneous portion of any substance. It is not without parts and therefore not indivisible. It is subject to disintegration. In a Bhūta or its isomeric modification, the Paramāṇu, the smallest homogeneous component particle, is unmixed, and therefore corresponds to the atom of modern chemistry. In a mixed substance (संयोगी, संयुक्त) whether it is an 'isomeric' or a 'polymeric' compound, the qualities are due to the mixture, and therefore its Paramāṇu, the smallest homogeneous particle possessing its characteristic qualities, must result from the mixture of the Paramāṇus (in smaller or larger numbers as the case may be) of the component substances. The Para-

longer interval still, for Vāchāpati ascribes the Bhāṣya to Veda-Vyāsa himself (वेदाभिस व्यासे अद्वितीयः शब्दः विवरणे). The internal evidence also points to the conclusion that the Bhāṣya cannot have been composed later than the sixth century,—cf. the quotations from Pañcasikha, Vārshaganya, and the Śaśbdi-Tantra-Sāstra, without a single reference to Iṣṭvara-Kṛishna—which is decisive. I may add that I remember to have come across passages of a similar import in Buddhist and other writings of a still earlier date.

mass of a mixed substance therefore corresponds to what we now call molecule. (परमाणुसंयोगं एव परमाणुस्ति—भास्त्रमात्रः । कोइस हि परिभ्रमणानक विकल्पदेव चक्षते तारतम्य व्यक्तिहै सः परमाणुसंयोगपरमाणुः—परमाणुति—तत्त्वं आदी—Sutra 52, Pada III.—माणुसिद्धता न विभजनः । इविवीपरमाणुः अपरमाणुरिक्षाद्विवरणात् इविष्वादीमात्रपरमाणुकाङ्गालिष्वादिष्वेष । विज्ञाम-विष्व—परमाणुमात्र । Sutra 88, Chap. V.)—That the Paramāṇus form molecules (परमाणु) in forming substances, is acknowledged by the Sāṅkhyas as will appear from Gaudapāda,—तत्र परमाणुभावं राज्ञामहेषाः । (नीडपाद, on Kārikā 12). Even the Vaisheshikas, with their prejudice against 'polymeric' or 'heterogenic' combination, acknowledge that in 'polymeric' compounds the different Bhūta substances unite by their Paramāṇus (or atoms), though they rigidly insist that in such cases only one atom should be regarded as the 'radicle' (उपाधाम or उभारणकर्त्तारम्) and the others be co-efficient causes (निमित्तकारणे—उपाधाम), e. g. श्रीराधार—पञ्च समुद्रपद्मेषु चतुर्थं लक्ष्मीमेषु अष्टमरक्षामिष्वामवा-वात् तिष्ठिष्वीद्वयः परिष्वपरमाणुस्तुष्वहितेष्वी दद्वद्व मुष्वपद्मे (श्रीराध-पादमात्र—where Śrīdhara notes परिष्वपरमाणुस्तुष्वहितेष्वी दद्वद्व मुष्वपद्मे and Udayana तेष्वात्मा परमाणुम् परिष्वपरमाणुस्तुष्वहितेष्वी दद्वद्व मुष्वपद्मे विष्वामिष्वामवा—वात् तिष्ठिष्वीद्वयः परिष्वपरमाणुस्तुष्वहितेष्वी दद्वद्व मुष्वपद्मे) ।

It is only in the mediæval Sāñkhya-Patañjala that under the influence of the Nyāya-Vaiseshika doctrine a radical difference was conceived to exist between the structure (or constitution) of a molecule composed of 'isomeric' atoms, and that of one composed of heterogenous (or 'polymeric') atoms. In the former case, there was believed to take place intimate union (उत्तम), in the latter case, only a grouping of comparatively free or loosely attached atoms round a radicle atom (अधृत), with liberation of Energy (उपरक्ष—प्रदर्शन—or विद्युत) and the setting up of unequal stress and strain (असमर्थविकर्त्ता—हेतुरक्ष). At the same time, it was of course admitted that this distinction does not apply to the forms of subtle matter (Tanmātra—तन्मृत) which could unite in intimate fusion, whether homogeneous or heterogeneous. For example, the subtle body (शुक्ष्मरीर) which is supposed to be the seat or vehicle of the conscious principle is acknowledged by Vijnāna-bhikshu to be penta-Bhautic (पञ्चभूतात्मक); in other words, all the five Tanmātras serve as material causes, though the gross body (the animal organism) is stated to be only a 'polymeric' compound with the Earth-Bhūta as radicle or base. अधिकानश्चरीरं च ततः पञ्चमूलात्मकं वस्त्वसे । तत्त्वावधारे यत् यूतपञ्चमं विहारिणं ब्रह्मरूपं (प्रवचनमाला—Sūtras

11 and 12, Chap. III.—*यज्ञस्त्रीव परिवर्तेव चकानि च
पूर्णानि उपरचकानि* (*ibid.*, Sutra 19, Chap. III.)

But in the original Sankhya-Patañjala it appears that the production of a new substance by mixture of unlike Bhutas (विभावीद्वयोऽत) was conceded as freely as in the Vedānta, and was conceived as nowise differing from the formation of a compound of atoms of the same Bhūta class. The Sāṅkhyā analysis of all change into transformations of Energy due to collocations of unchanging Gunas, in other words, the prevailing chemico-physical (or physical) point of view, naturally recognises no distinction between collocations of 'isomeric' and those of heterogeneous (or 'polymeric') atoms. At bottom they are all collocations of the Gunas. Even Vijnanabikshu who, as one of the latest expounders of the Sāṅkhyā-Patañjala, has been most affected by the Vaisesika prejudice against 'polymeric' combination (विभावीद्वयोऽत) urges that the qualities of a compound substance are not necessarily the result of similar qualities in the component elements. (इति तु तेषां (वार्षिकात्) एष च निष्ठः ।) Elsewhere he explains that far from the vital activity being independent it is originated and maintained by the combined operation or fusion of the different sensory and motor reflexes of the living

organism, and notes that the united operation of mixed (or miscellaneous) causes, where there is a fit collocation of matter, offers no difficulty to a follower of the Sāṅkhyā-Pātañjala :—(वातिदाहयं चाकाशमदो-
वलाम्, सामयीस्मवधाने मति अनेकेष्वपि रूपादेः एवहा एव उत्तु-
पादने वायज्ञ वाति—एवचन्द्राण्, Sūtra 82, Chap. II). In the
middle of the ninth century, we find Vāchaspati
instancing some 'heterogenic' or 'polymeric' composi-
tions as typical examples of evolutionary change
(परिवाप) and unhesitatingly accepting the substan-
tive character of the products. In the Kāvyaśāstra he
describes the various acids and juices of fruits as
modifications of the same original water in the pre-
sence of different kinds of earthy accretions. The
process is peculiar. The water-particle (or atom)
serves as a radicle or centre of a system, and the differ-
ent kinds of the Earth-Bhūta centering round this
as a nucleus become the seat of forces, which bring
in the development of new energies (and new qual-
ties, e.g. tastes) in the water. वा वारिदिग्निसुदकं
एवरक्षन्ति तत्त्व-मूलविकारान् चामात्र वारिदिग्निसुदक-विक्र-विकार-
रक्षतदा परिवापान् लभ्यात्तदवस्थातिक्षणदुक्षावतदा विकासते। इति
व्येक्षयवस्थवान् प्रधानदुक्षम् वारिदिग्निसुदकः परिवापमेदान्
वद्येद्यति। (कीमुदी on Kārikā 16). Vāchaspati also
points out that different substances may be
transformed into one and the same substance (e. g.

the production of salt by the cow, the horse, the buffalo and the elephant, thrown into the salt factory of Sambhar in Rajputana or of the flame of a candle by the combination of wick, oil and fire. (परिवामेषत् वहनामयि इवः परिवामः हस्तः। तदैवा वायाम-
वहिवामात्रानां वसानिविमानां वक्ष्यत्वत्वातीवलक्ष्यः परिवामः।
वर्णिवामवामां च वदीय हस्तः—तत्प्रेक्षारदो ओ वाहाम्, Pada
IV. Sutra 14.)

Earlier still, i.e., not later than the sixth century, the Vyasa-Bhashya, noting that inorganic matter, vegetable substances and animal substances do not differ from one another essentially in respect of their potential energies and ultimate constituents, points out that various bi-Bhautic chemical compounds of water and earth substances, in the shape of saps, acids and juices, are found in plants in their different parts (जडसूक्ष्मः परिवामित् राजिवेष्टनं
ज्ञायेद् दृष्टम्). In other words, bi-Bhautic compounds are here placed in the same category as 'isomeric' compounds of substances of the same Bhuta class, for here the particles of both the Bhutas are regarded as forming the matter (material cause—उपादामकारण) of the smallest homogeneous portions of the compound substances.

N.B.—Vichaspati naturally interprets this to mean separate modifications of the two Bhutas.

The view of the earlier Sāñkhyas that atoms of different Bhūtas may chemically combine to form molecules of compound substances as much as atoms of different modes of the same Bhūta comes out clearly in Utpala's brief reference to the Sāñkhya system in his commentary on Varahamihira's Vṛihat Saṁhitā (एवः पच्च [तत्त्वादेवः] पच्चमाभूतानि भूतिः । तेषाः परीरिका ब्रह्मरात्रिः । यतः पच्चमाभूतपदाणि ब्रह्मरात्रिः Utpala, Chap. I, S'loka 7).

Chemistry in the medical schools of ancient India :—As a matter of fact, long before the fifth century, probably as early as the first century A. D., the prevailing schools of medicine and surgery which were based on the Sāñkhya teaching with a methodology derived from the Nyāya-Vaisesika doctrine (cf. Charaka, Sāriṇīmethāna, Chap. I, Vimānasthāna, Chap. VIII—also Susruta, Sāriṇīasthāna, Chap. I) had founded an elaborate theory of inorganic and organic compounds, which equally admitted iso-Bhautic and hetero-Bhautic combinations. Like the Vedantists, Charaka held that each of the gross Bhūtas (Mahabhūtas) is a peculiar ultra-chemical compound of five original subtile Bhūtas. In this sense, every substance is penta Bhautic, but for purposes of chemical analysis and synthesis, i. e. considered with reference to the Mahabhūtas, all substances in their chemical constitution, belong to

one or other of the following classes : Mono-Bhautic, bi-Bhautic, tri-Bhautic, tetra-Bhautic, and penta-Bhautic. Compounds of different Bhutas, again, may combine to form more complex substances, and these in their turn, higher compounds still, and so on in progressive transformation, as is more specially the case with organic substances and products.

Physical characters of the Bhutas:— The prevailing physical characters of the different Bhutas and their isomeric modes are enumerated as follows.

Earth-substances—Heavy, rough, hard, inert,
dense, opaque, exciting
the sense of smell.

Ap-substances—Liquid, viscous, cold, soft, slippery, fluid, exciting the sense of taste.

Tejas-substances—Hot, penetrative, subtle, light, dry, clear, rarefied, and luminous.

Vāyu-substances—Light, cold, dry, transparent,
rare-fied, impinging.

A kina-substances—Imponderable (or light), rarefied, elastic, capable of sound (vibrations).

(नुदवाह क त्रिलम्बकिरणविषदसामू-स्ट्रोमभग्नवहुतानि पर्याप्तिः ।
इष्विष्वभीतमन्दवद्विष्विक्तस्त्रुत्यवहुतानि वाप्तानि । उच्चतीक्ष्ण-
स्त्रुत्यविषदद्वयमन्दवहुतानि वाप्तेयानि । स्त्रुत्योतक्ष्णविषदस्त्रुत्यव-

दुष्प्रवृक्षानि वायवानि । चटुचपुत्राद्युपाद्युष्मानि आकाशानि—
कालः ।—Charaka, Sáriñasthána, Chap. 26 ; compare
Susruta, Sútrasthána, Chap. 41).

Charaka points out that the primary qualities or specific physical characters of the five Bhütas are tactile qualities, i. e. sensible to touch, e. g. hardness (or roughness) for Earth, liquidity (or yielding to pressure) for Ap, impelling or moving force (pressure) for Váyu, heat for Tejas, and Vacuum (non-resistance, penetrability) for A'kasha.

(चारादेवयोधत्तं मूलभानिकानेऽनाम् ।

आकाशाद्याद्योक्ताते हृष्टं विष्टं व्याकुलम् ।

वस्तुतं दर्शनेऽनेतत् अद्योऽनुशोधरम् ।

Charaka-Sáriñasthána, Chap. I.)

(cf. the elaborate enumeration of physical characters quoted in Vijñána-bbikshu, Yoga-Vártika, Sutra 42, Pada I ;—also Varavara's commentary on Tattva-traya Achit-prakarana).

The Maha-Bhütas—mechanical mixtures :—
Susruta notes that each of the gross Bhütas (Maha-bhütas) is found mixed up with the other Bhütas ;—e. g., the Maha-bhûta A'kasha is the receptacle (or vehicle) of air, heat-and-light, and water vapour ; the Maha-bhûta Váyu, of water-vapour, light-and heat, and even fine particles of Earth held in suspension ; the Maha-bhûta Tejas, of earth-particles in the shape of smoke, and also water-vapour.

(सुरुतोऽनामुद्दितानि सुर्वायेतानि चिह्नहेतु—Susruta, Sarirasthâna, Chap. I.) ये पूर्ण वस्तु व्यापक हैं। आवाहि पदम्-
दहम्-तीवानि। वाषी रेतोद्धृती। मूरपि वस्ताविहेतु। भूमिरपि
भूमादिकरिक रेतहि। रेतोद्धृते वालीयसपि—Dalvana on
Susruta, loc. cit.)

Mono-Bhautic Earth-substances :—Charaka and Susruta regard the following as Earth-substances—Gold, the five Lohas (silver, copper, lead, iron and tin) and their 'rust', arsenic, orpiment, various mineral earths and salts, sand, precious stones, (Charaka, Sûtrasthâna, Chap. I. Cf. also Susruta, Sûtrasthâna, Chap. I—पतिष्ठात् तु वर्चरजस्तविसुकामनः-
प्रिना वस्तवपाकादयः। सुर्वक्षम इह पार्वितवस्तिवृष्टिवस्ति वृष्टवस्तातिक-
मेष्टोदिवंतुभिः। तृष्ण वादिवहकान् लोहमलविकातासुशाहरतावस्तवस्त-
विरिवरसः तु वस्तीया—Dalvana on Susruta, loc. cit.)

The salts include common salt, saltpetre, etc. Susruta mentions, the alkalis, borax, natron, Yavakeshâra (carbonate of potash) etc. The Aundhida salt, an inflorescence of the soil, stands for reh (रेहि वायवर्ज वस्तात्मुनिः लवम्).

Of these Earth-substances, some were known to be compounds, e. g. the chemical salts of the metals, collyrium etc. Susruta describes the preparation of the metallic salts. The leaves of the metals were pasted over with the salts, and then roasted (वस्तवति) (Chikitsâsthâna, Chap. 10). These metallic salts are therefore mono-Bhautic Earth-compounds. Susruta also gives the preparation of mild and caustic alkalis. (Sûtrasthâna, Chap. 11.

Origin of precious stones :—Some hazarded the guess that the precious stones are rocks (or earths) metamorphosed by natural process in the course of ages (Varahamihira—वृषभामिहिरः शास्त्रपत्रानाम् वैचित्रं सुकृताणाम्—Utpala notes, — उत्पलं प्राप्ताः काषायकैवल्य).

Ap-substances, simple and compound :—

Susruta, following Charaka, enumerates various classes of Ap substances (अपद्रव्य) as follows :—waters, acids, milks, curds, butters, oils (vegetable as well as animal), fats, honeys, molasses, alcoholic liquors, urines etc.

Pure Ap (Mahābhūta) is tasteless and the six tastes are developed when the Mahābhūta Ap enters into combination, mechanical or chemical, with other Mahābhūtas. Susruta notes that various kinds of Earths are dissolved in the waters of different localities, and where the particles so dissolved are predominantly Earthy, the water tastes acid or salt,—where predominantly watery, the resulting taste is sweet,—where the Earth particles are mixed up with Tejas, the water tastes pungent or bitter etc. Such is the case with mechanical mixtures. In the case of bi-Bhautic or tri-Bhautic compounds Charaka mentions that substances with Mahābhūta Ap predominating in their composition taste sweet; with Mahābhūtas Earth and Tejas predominating, acid; with Mahābhūtas Ap and Tejas predominating, salt; with Mahābhūtas Vāyu and Tejas predominating, pun-

gent ; with Mahābhūtas Vāyu and Akṣa predominating, bitter ; and with Mahābhūtas Vāyu and Earth predominating, astringent (Charaka, Sūstrasthāna, Chap. 26.—cf. Susruta, Sūstrasthāna, Chap. 42).

In fact with the exception of Susruta's waters which are mechanical mixtures, or rather solutions, all these Ap-substances are organic products and, as such, penta-Bhautic, i. e. compounded of all the five Mahābhūtas, and the particular 'taste' which is developed depends on the relative proportion of the Mahābhūtas, and the predominance of one or more of them in the penta-Bhautic compound in question.

Qualities of Compounds.—The isomeric modes of each Mahābhūta have specific colours, tastes etc. due to their structure, i.e. the arrangement of their atoms, and the physico-chemical characters of compounds whether of the same or of different Mahābhūtas result from the collocation in unequal proportion of the different forces latent in the atoms of the component substances. Charaka adds that the varied forms (textures) and colours of organic substances, whether vegetable or animal, are derived in the same way.
 एकस्मितां रसाना पट्टमुण्डपत्रं चूनातिरेकदिविशान् नहायतानान् ।
 मृतानानि च ज्ञायरज्ञनानां चानादर्थाङ्गतिविदेषाः ।

Susruta ignores Charaka's distinction between Mahābhūta and subtle Bhūta, and views every

substance as in reality penta-Bhautic and it is only the relative predominance of a particular Bhūta or Bhūtas in any substance that determines its class. (पृष्ठवस्त्रेभोवायुक्तामाना उमुदावात् द्वयामिनिष्टिः । चतुर्वर्षा चिकित्सा को मध्ये इह पारिं इह पापं इह तीव्रं इह शायमं इह चाकाशीषमिति । Susruta, Sūtras-thāna Chap. 41)

The extant Charaka and Susruta—Succession of medical authorities :—

The extant Charaka and Susruta, the sources of our present information regarding the progress of scientific knowledge in the medical schools of Ancient India, are both redactions of original authorities. The extant Charaka is a redaction by Dridhabala of the genuine Charaka Samhitā which was itself a redaction by Charaka of the original work of Agniveśa, the disciple of A'treya Panarvasu as distinguished from Krishnatreya and Bhikshu A'treya, also well-known medical authorities. The extant Susruta is a redaction by Nāgārjuna of an original work (Vriddha Susruta) by Susruta, the disciple of Dhanvantari. That Charaka preceded Susruta is almost certain. Nāgārjuna was probably earlier than Dridhabala. At any rate, Dridhabala imported into Charaka much of the surgical knowledge which had till then been the traditional heritage of the Susruta school. And in the matter of the surgical treatment of certain diseases, the genuine Dridhabala is often as

advanced as Susruta's redactor himself. The latter was probably identical with the alchemist Nāgārjuna (Siddha Nāgārjuna), the metallurgist Nāgārjuna (author of a treatise on metallurgy, *Lohas'āstra*), and the Buddhist Nāgārjuna, author of the *Mādhyamika-sūtravitti*. Charaka and Susruta continued to receive additions after Dridhabala and Nāgārjuna, and even after Vāgbhata, but the whole of the extant Charaka is probably much earlier than the commentator Chakrapāni, and the whole of the extant Susruta earlier than Dalvana, the commentator, and Mādhava, the author of *Rugvinischaya*. The extracts in Vāgbhata make it certain that the passages I have quoted or shall quote from the Sūtrasthāna and Sākrasthāna of Charaka and Susruta cannot be later than the sixth century of the Christian era.

Preparation of Chemical Compounds.—The knowledge of chemical compounds and of their preparation continued to make progress in the Charaka and Susruta Schools. The great metallurgist, Patañjali, in his treatise on Metallurgy (वैद्यराज) gave elaborate directions for many metallurgic and chemical processes specially the preparation of the metallic salts, alloys and amalgams, and the extraction, purification and assaying of metals. Probably it was Patañjali who discovered the use of the mixtures called *Vidās*.

which contained aqua regia or other mineral acids in potentia. Unfortunately Patañjali's *magnum opus* appears to have been lost, but extracts from it are frequently found in mediaeval works on Medicine and Rasayana, which leave no doubt as to its remarkable scientific value. The metallurgist Nágárjuna advanced the knowledge of chemical compounds by his preparations of mercury. The *Harsabharita*, in the seventh century, relates a fable concerning this Nágárjuna, and speaks of him as a friend and contemporary of Sátaváhana. The relative priority of Patañjali and Nágárjuna is a vexed question in the history of metallurgy. That Nágárjuna's *Lobásatra* was earlier than the final redaction of Patañjali will appear from the following circumstances :—(1) Chakradatta in his summary of Nágárjuna mentions that the chemical process of testing pure iron must be repeated twice before it can be regarded as decisive, whereas S'ivadéva Sen's extract from Patañjali shows that the latter directed the process to be repeated seven times ; (2) Patañjali in the *Abbraka-vidhi* (mica operation) adds mercury, which in this particular operation is wanting in Nágárjuna's recipe (cf. Chakradatta, and Patañjali as reported in the *Yogoratnákara-saṁucchaya*) ; and (3) Nágárjuna is quoted in the earlier compilations, Patañjali in the later.

Early in the sixth century, Varáhamihira in the

Vribat Sambita gives several preparations of cements or powders called Vajra-lepa "cements strong as the thunderbolt;" and there was ample use for these in the temple architecture of the Buddhist period, the remains of which bear testimony to the adamantine strength of these metal or rock cements. (वाज्रालेपं रक्षाद्युपासनादोः । Chapter 56, *Ibid.*). Varāhamihira also alludes to the experts in machinery (वर्करिदः, वर्काचारः) and the professional experts in the composition of dyes and cosmetics (रामदण्डुक्तिविदः Ch. 16, also Ch. 15). I would also refer to the interesting Chapter on Perfumery (Ch. 78) where Varāhamihira gives various recipes for artificial imitations of natural flower scents as of the essence of Vakula, Utpala, Champaka, Atimuktaka &c., arranges compound scents in a sort of scale according to the proportions of certain ground essences used in their preparation, and determines by the mathematical calculus of combination (नीटव्याकार) the number of variations of the different notes in this scale. To these classes of professional experts were due three of the great Indian discoveries in the chemical arts and manufactures which enabled India to command for more than a thousand years the markets of the East as well as the West and secured to her an easy and universally recognised pre-eminence among the nations of the world in

manufactures and exports :—(1) the preparation of fast dyes for textile fabrics by the treatment of natural dyes like Mañjishtha with alum (मूळी अल्मः रात्रियज्ञी) and other chemical (e. g. sulphate of iron) also cow-dung (cf. the "cowdung substitute", Roscoe) ; (2) the extraction of the principle of indigotin from the indigo plant by a process which however crude is essentially an anticipation of modern chemical methods ; and (3) the tempering of steel in a manner worthy of advanced metallurgy, a process to which the mediæval world owed its Damascus swords. It was this applied chemistry much more than handicraft skill which gave India her premier position in the middle ages and earlier (indeed from Pliny to Tavernier) in exports and manufactures ; for in handicraft skill as in design and workmanship, great as were her merits, India came to be surpassed by her disciples China and Japan.

The Visavadatti and the Devakumara Charita in the sixth century allude to the preparation of a mass of fixed or coagulated mercury (पारद-पिण्ड इव वायवातुकादिनः—वायवदना) ; a chemical powder, the inhalation of which would bring on deep sleep or stupor (वैष्वानं—दमतुकारात्रित) ; a chemically prepared stick or wick for producing light without fire (वीदवर्तिका—दमतुकारात्रित) ; and a powder which like anaesthetic drugs or curare, paralyses

sensory and motor organs (असन्धर्तिः इत्यादात् —साहस्राः—वीक्षकार्थेन्द्रियाभिति हृषिः). Vrinda (circa 950 A. D.) notices the preparation of sulphide of mercury (रुद्रामधुर्व) composed of one part of sulphur, and half its weight of mercury ; and also of cuprous sulphide (पर्फिलाम्). Chakrapani (circa 1050 A. D.) mentions the preparation of the black sulphide of mercury, "by taking equal parts of mercury and sulphur".

The Raśīrnava (circa 1200 A. D.) notices the colours of metallic flames, probably after Patañjali : e. g. copper gives blue flame ; tin, pigeon-coloured ; lead, pale ; iron, tawny : blue vitriol, red. It may be noted that the Raśīrnava regards mercury as a penta-Bhautic substance.

The Rasaratna-samuchchaya divides the mineral kingdom (Earth-substances, simple and compound) into the following classes :— (1) The eight Rasas, mica, pyrites, bitumen, blue vitriol, calamine, etc. (2) The eight Uparasas (useful in operations of mercury), sulphur, red ochre, green vitriol, alum, orpiment, realgar, collyrium, and medicinal earth, to which may be added the eight Siddhārtha Rasas, sal-ammoniac, cowrie, cinnabar, rock vermillion, etc. (3) The gems, diamond, emerald, sapphire, cat's eye, sun-stone, moon-stone, pearl, etc. (4) The metals,

gold, silver, iron, copper, lead, tin, and the alloys—brass and bell-metal. Other Earth-substances are six salts, three alkalis, mineral earths, and several poisons (cf. vol. I, pp. 82-88).

Chemical compositions and decompositions—metallurgic processes.—In these writings, we frequently come across instances of chemical composition and decomposition, by processes, more or less crude, of calcination, distillation, sublimation, steaming, fixation, etc. (मसीधरण वसातन, चहंपातन, खेदन, उचन etc.) e.g. the preparation of perchloride of mercury by taking common salt and mercury (रसक्षयू—पारदम चेत-मसीधरण वसातन); of sulphide of mercury (हित्य) by taking sulphur and mercury; of Sindura from lead (हित्य वाक्षवाद्य—Amarakosha sixth century A. D.);—of the medicinal compounds, Svärna-sindura and Rasasindura, with mercury, sulphur and gold, where gold may have been fancied to influence the resulting compound in some mysterious way, either as a 'dynamic' or as a catalytic;—also the extraction by chemical decomposition of mercury from sulphide of mercury (हित्य,—vide रसरक्षमुद्य); of copper from sulphate of copper (तुला, वस्त्र) by heating this substance with one-fourth of its weight of borax (Rasaratna-samuchchaya,—cf. Bhūvaprakīsa, तुला

तु साक्षीपदातु विद्युत् तावेष गहयति) ; of zinc (पचास, चहर) from calamine (रसव—Rasirnava) ; of copper from pyrites (मालिक, विसवा, etc.—Rasirnava, (though the golden pyrites were supposed to be a semi-metal of gold, containing some gold along with the essence of copper)—the purifications of mercury by repeated distillation from lead and tin with which it was wont to be adulterated in the market. The various metallurgic processes described are—extrac-tion, purification, killing (formation of oxides, chlorides and oxy-chlorides for the most part), calcination, incineration, powdering, solution, distillation, precipitation, rinsing (or washing), drying, steaming, melting casting, filing, etc. to all which each of the known minerals was successfully subjected by the use of apparatus and reagents and the application of heat in different measures (घरणा—मध्यमपात्र— and अद्यात्र),—methods which, if often crude, especially from the absence of independent and isolated mineral acids, were yet in several instances remarkably simple and effective, and which, after all by the use of various Vidas potentially containing mineral acids aqua regia, sulphuric acid, hydrochloric acid, etc.) virtually accomplished the practical ends kept in view. To these were added several special processes for mercury (e. g. fixation), bringing up the number of mercurial operations to nineteen.

It may be noted that the mixtures called *Vides*, which potentially contained dilute mineral acids, were regularly employed not only in killing the metals (forming their oxides and chlorides), but—what is of fundamental importance—for purposes of chemical decomposition of metallic salts, etc. and the extraction and purification of metals.

Organic Compounds.—Organic Compounds are either vegetable or animal substances (जागर जड़न शूल). The molasses, the fermented liquors, the sap and juices of plants, fruit acids, vegetable ashes and alkalis together with the tissues of plants are vegetable compounds (जीवित जागर शूल). Honey milk, curd, butter, fat, bile, urine, and other excreta, together with the organs and tissues of animals, are animal substances. Charaka notices vegetable as well as animal oils. The viscous (nily) substances are classed under four heads—butters, oils, fats, and marrows (कर्पोर वसा मत्ता बोहो द्रव्यगुप्तिः). Salt may be either mineral or vegetable salt.

Susruta divides poisons into two classes—Vegetable and animal, but several poisons expressly termed mineral poisons (शूलेष) are included in the first class.

All organic substances, whether animal or vegetable, are penta-Bhautic, being compounded

of greater or less proportions of the five Maha-bhutas.

Taking the human body Charaka finds that the fetus is composed of sixteen organic substances, viz. four, composing the Sperm-cell which comes from the male; four composing the germ-cell which comes from the female; four added by the transformation of the nutritive material, and finally, four kinds of subtle matter, which together form the vehicle of the conscious principle. As to the four organic substances which compose the sperm-cell, or the other four which compose the germ-cell, it is not clear whether in Charaka's view they are also in their turn compounded of less complex organic substances, or whether their constituent elements are inorganic penta-Bhautic compounds.

The tissues that appear in the course of developments of the fetus are further transformations (higher compounds) of these fetal substances. All the component substances of the body are penta-Bhautic compounds, though sometimes they are assigned to the particular Bhutas which predominate in their composition, e.g. bile to Tejas, lymph, chyle, blood, fat, urine, sweat and other secretions to Ap. and skin, flesh, bones, nails, hair, etc. to Earth. (एवं पापुषेभूम्यभूतपाद्यन् ।—सर्वस्ते एवाचर वस्तुविधानि मूलाणि

मातापितृद्वयानि वाहारानि वायव्यानि चेष्ट et seq. Charaka, Sáriasthana, Chap. II. vide also Charaka, Sáriasthana, Chap. VII. cf. Gangádbara's Jälpaikalpataru. विन इतीर्थं मूलं श्रीरात्रकृतिः वशानपव्यूत-
विकारामसं त्रिः सहप्रयिमेभ्यः। वषवतुवे भूतमायः श्रीरात्रकृतिः-
वशानपव्यूतविकारविदिः। श्रीर तु पवनः भूतविकारमयुदावायकम्।
Cf. Charaka Sáriasthana, Chap. IV. मातापादवीडिपि एव
महाभूतविकाराः।)

Fœtal Development (after Susruta). The ovum fertilised by the sperm-cell and developing under the influence of animal heat forms successive layers and tissues even as layers of cells and fibres are formed in wood. First are formed seven layers epithelial and dermal (प्रस्तरः), then follow the several tissues (प्रथा), the flesh, the vascular tissue, the fat and marrow, the lymphatic (and glandular) tissue, the intestinal tissue, the biliary and the seminal vessels,—tissues which are regarded by some as modifications of the original dermal layers of the ovum (cf. the layers of the blastoderm and their relation to the tissues in Embryology). The tissues are supposed to be developed successively, one out of another, by chemical action or metabolism (प्राप्त). e.g. chyle is transformed into blood, blood into flesh, flesh into fat, fat into bone, bone into marrow, marrow into sperm-cell. The organs are next formed out of the tissues. The liver, gall-

bladder (खोन). spleen and lungs are referred to the blood ; the intestines to the blood, lymph and bile ; the kidneys to the blood and fat ; the testicles to the blood, lymph and fat ; the heart to the blood and lymph ; and the tongue to the lymph, blood and flesh. Vāyu, with the accompaniment of animal heat, impels the 'currents' (चौरात्रि) in the system ; Vāyu acting on the flesh gives rise to the muscles, and it is Vāyu again, which, with the essence of fat (or marrow), produces the nerves, arteries and tendons. (तत्त्व उच्च एव चौरात्रिः परिपक्वानन्तरं चौरसेव कलानिकाः सप्ततीव मवति ।—सप्ताः सप्तपि एव सप्तशति । द्वयाति सात् चाहेतु द्विष्टमामेतु हत्यते । तातो द्वया नीडपरा । द्वितीया रक्तपरा । द्वतीया मेदोध्या । चतुर्थी द्वेष्टपरा । पञ्चमी पुरोषपरा । षष्ठी विज्ञपरा । सप्तमी षष्ठपरा ।—अथवा बहुत्त्रीहानी ग्रीष्मिकाः ।—et seq Susruta, Sārīrasthāna, Chap. IV.—रक्ताद्वयं तत्ती नाते नाशादेदः सप्तादेति । मेदोद्युष्टि तती नात्या नातः एव एव एव । Sūtrasthāna, Chap. XI V.)

The following parts (tissues and organs) in the fetus are in a special sense modifications of the four organic substances contributed by the sperm-cell of the male parent ; hair, nails, teeth, bones, nerves, veins and arteries, tendons and ligaments, and the sperm-cell ; the following, of the substances derived from the mother,—skin, blood

flesh, fat, the heart, liver and spleen, kidneys, stomach, intestines, etc. (Charaka, Sushrastha, Chapter III. वानि खलस यमेष पित्रकामि प्रदत्तः कृष्णवानि, तदवया वैज्ञ-यन्-गुण-सोम-इकाक्षितिरा-वायु-धनवः यज्ञ-विति पित्रभानि। वानि खलस यमेष वाहकानि वानि च वज्र-मात्रतः कृष्णवानि—तदवया तत् च वीडितव भास्तु विद्युत् च वज्रं च त्रीहा च इष्टो च पुरीषादात्र च चामाशय इति वाहकानि।)

Chemistry of Digestion—The food we eat contains five classes of penta-Bhautic organic compounds. From their radicles or predominant elements, the substances are named Earth-compounds, Ap-compounds, Tejas-compounds, Vāyu-compounds and A'kasa-compounds. The Earth-compounds supply the hard formed matter of the body, the Tejas-compounds give the animal heat (or the metabolic heat), the Vāyu-compounds are the sources of the motor force in the organism, the Ap-compounds furnish the watery parts of the organic fluids, and the A'kasa-compounds contribute to the finer etheric essence which is the vehicle of the conscious life. Roughly speaking, the Earth-compounds answer to the nitrogen compounds in the food, the Tejas-compounds to the hydro carbons (heat-producing) and the Vāyu-compounds to the carbo-hydrates (dynamic). The Ap-compounds are the watery parts of food

and drink. The flesh, for example, is a tissue composed principally of the Earth-compounds, the fat of the Earth and Ap compounds, the bones of Earth Vāyu and Tejas compounds. The Tejas compounds predominate in the composition of the blood. For purposes of digestion it is stated that different operations of the metabolic heat (perhaps different digestive fluids are also meant) are required to digest the different substances in the food.

The course of metabolism is described as follows :—The entire alimentary canal is called Mahārotas (the great channel).

The food goes down the gullet by the action of the biomotor force, the Prāna-Vāyu.

In the stomach (वाय्य) the food becomes mixed up first with a gelatinous mucus (तेलीमूत्र वर्ष) which has a saccharine taste, and then gets acidulated by the further chemical action of a digestive juice (विदाहादकता वर्ष)—evidently the gastric juice is meant. Then the biomotor force, the Samāna Vāyu, begins to act and drives down the chyle by means of the Grahanī Nādī to the Pittāsayn (duodenum), into which bile comes down from the liver, and thence to the small intestines (the जानपदाशय). In these, the bile (or rather the digestive substance in the bile as opposed to the colouring element) acts on the chyme, and converts the latter into chyle (रस), which has at first

a Katu taste (pungency). This chyle contains in a decomposed and metamorphosed condition all the penta-Bhautic organic compounds, viz. tissue-producing Earth-compounds, water parts or Ap-compounds, heat-producing Tejas-compounds, force-producing Vāyu compounds, and lastly, finer etheric constituents which serve as the vehicle of consciousness. The essence of chyle (च्यूल) from the small intestines is driven by the biomotor force, the Prūna Vāyu, along a Dhamanī trunk (cf. the thoracic duct) first to the heart (which is a great receptacle of chyle), and thence to the liver (and the spleen), and in the liver, the colouring substance in the bile acts on the essence of chyle, especially on the Tejas substance therein, and imparts to it a red pigment, transforming it into blood. But the grosser part of chyle (च्यूल) proceeds along the Dhamanis, being driven by the biomotor force, the Vyāna Vāyu, all over the body.

When the blood has been formed, the essence of chyle in the blood, acted on by Vāyu (biomotor force) and Māmsagni (the flesh-forming metabolic heat), forms the flesh tissue, the Earth-compound of the food substance especially contributing to this tissue. Of the flesh tissue thus formed, the grosser part goes to feed or replenish the flesh tissue all over the body. The finer essence of flesh in the

blood in the chyle, acted on again by Vāyu (biomotor current) and the fat-forming metabolic heat (मेटाफि) in the menstruum of lymph (लय वसाहित), receives viscosity and whiteness, and produces the fatty tissue, the Earth-compounds and Ap-compounds of the food especially contributing to the product. This fat in the chyle (or blood), or rather the grosser part of it replenishes the fatty tissue of the body, but the finer essence of fat in the flesh in the blood in the chyle, acted on by Vāyu (biomotor current) and the marrow-forming metabolic heat, in the menstruum of lymph (लयवसा), becomes hard (or crystalline), and forms bone, the Earth, Vāyu and Tejas compounds contributing principally to the product. The essence of the fat fills the hollow channels of the bones, and acted on again by biomotor Vāyu and metabolic heat, becomes transformed into the marrow. The marrow is transformed into the semen, which is conveyed down by means of a pair of Dhāmanis (ducts) (द्वारा द्वारा), lodged in its receptacles (शरण—इन्द्री) and discharged by means of another pair of ducts (द्वारा द्वारा). The semen, or rather all the elements in their finer essence, give off Ojas, which returns to the heart, the receptacle of chyle and blood, and again floods the body, and sustains the tissues, thus completing the wheel (or self-return-

ing circle) of metabolism (परिचक्षित चक्रः). Of Charaka and Vāgbhata).

It is to be noted that, throughout, the fluid in the chyle (or blood) acts as the menstruum, though occasionally the lymph, which is itself a derivative from the chyle is added as in the case of the fatty tissue and the marrow; and that each preceding element or constituent of the body (पादु—जटीयाद्यचक्रान्) takes up the proper organic compounds from the food-chyle to form the next element or tissue. Throughout also, the chemical changes are due to the metabolic heat which breaks up the compounds and recombines, but the operations and even the vehicles perhaps of this heat are different. For example, these heat-corpuscles in the biliary ducts produce the bile, but the bile secretion is supposed to contain two distinct substances, (1) a digestive fluid in the duodenum (पिण्डाद्व) which acts on the chyme to produce the chyle, (प्रसाधनाद्यचक्रान् पिण्ड) ; and (2) a colouring bile substance in the liver which adds a red pigment to the chyle and transforms it into blood (रक्ताद्व पिण्ड). Besides, there are three other biles, of which the aqueous humour in the eye is supposed to be one (आत्मोद्यचक्रपिण्डम्) helping in the formation of visual images (कृपाहक्षम्). This is the view of Dhanvantari and his school, but Ātreya holds there is no

evidence that the bile really performs the first (digestive) function, for this can be accounted for by the animal heat arising from the working of the whole bodily machine. There are three different hypotheses regarding the course of metabolism and the successive transformations of the chyle (चौरदिवित्य-वैद्य गोकुलाचार्य वालेश्वरीतन्त्रादैति विदा शास्त्रीष्वच्छ-
ष्टः—Chakrapāni, Bhānumati, Sūtrasthīna, Chap. 14, S'loka 10; also his commentary on Charaka, Sūtrasthīna, Chap. 26), but my account is based upon the second hypothesis which has the preference of Chakrapāni (चारणः). It may be added as a curiosity that each element of the body (जीव) under the metabolic heat is supposed to give off a finer essence (प्रसाद) which serves as the material of the next succeeding element, and a dross (मधु), which forms some of the excreta in the body (including the nails, the hair, etc.), besides retaining its own substance (the gross or main part) which is driven along by the Vāyus (biomotor or vital currents) or by the Srotas to its destination in the body. Some idea of circulation appears to have been entertained, for the heart which receives and then sends down the chyle through the Dhāmanis gets it back transformed into blood, and the Ojas also proceeds from the heart and returns to it along with the chyle and blood. (Cf. Vāgbhatta—सः चतुर्मात्रः विदा रसायनं शोषः

चमिवहस्तः)। पश्चमूलाद्यके इह आहार पाषाणोत्तिकः। विषः पश्चात् वज्रदुषान् आप्तमिवर्हयेत्। Susruta, Sutrasthana, Chap. 46. Cf. also विषप्रवर्तनातात्पा इहिमाऽत्रोति मावतः। वातेवमेव वहस्तं तेन पित्तनुदोषते। Ibid., Chap. 41. गौमापापेवावस्थाः पश्चीमात्तः क्षमामस्तः। वैचाहारगुणान् साम् खान् पार्श्विकादीन् पश्चवत्। वशाव ते च तु चक्षिति पश्चा भूष्टुषान् वहस्त्। पार्श्विकः पार्श्विकेव देशः देशात् इहवान्। चतुर्विक्षितानुका रसे वहस्तेन्ति तु पार्श्विकः। मिदस्तपा मुखदाक्षिण्यविषमिकात्रसाम्। Charaka, quoted by Dalvada एतदी वहस्तमवस्था नहींभूतमोरयेत्, केवोभूतं वक्तं याति विदाहादवस्थावतः। वायुमा उमानालोके वहस्तीविषीवते। वहस्ती पित्तधरा वायु वा वशा परिक्षीर्तिता। वायुपक्षावशास्त्रःवा वहस्ती वायुविषोदते। चत्वारिंहावलवस्था वहस्ताद्यहस्ती नता। मुखनामास्ते वशा वा विषाच वशवस्थः। वशवशवस्था लक्ष्मानमेव विमुचति।...वहस्त पश्चा पित्तनु पाषाणात्तः पुरीरितम्। दीपशात्-क्षादीनामुख्यमेवावेदवादम्।...तेजोरक्षानां सर्वेषामनुकाली वदुच्छते। पित्तीचक्षा वशविष रसो रक्षवशवस्थति। वायुपित्तेवस्था तु रसे रसे वाहत्तमूच्छति। केवलाव च समाप्तिव मात्र वायुपित्तं तु तम्, किरदानाप्य गौडां च मेदो इहिमित्रावते। पुष्टिविषमिकादीनां वाहातः वैवशाहतः। वहस्तं प्रकरीक्षन् वायुपित्तम् तत्ती वशाम्। वर्णेति वशा गौविष्यमस्तु नप्ते क्षमीरकः। मिदसा तानि पूर्णते लेहो वशा वशः कृतः। तत्काम्पलक्ष्य वः लेहः वशः वंशावते नतः।

Charaka—Dridhabala Sambita, quoted by Aruna in his commentary on Vigbhata. यथा दिवारनिषत्ता तु चारसं
व्याहारी दिवारोमाडावदति, तथा एव प्रथमं रसं इवदति
तथा रक्तसाम-रक्तसाम् रक्तसाहस्रं रक्तवपदेशं च रक्तमवति;
रसं च रक्तहमादेन कीरिमात्रेन एव' पौष्टवति। तसी रक्तमाडाव
माडावातवति, एवमुखरोजरक्तानुः एव एव इवदति। (Chakradatta,
Bhanumati). This passage shows that the 'venous blood' was conceived to be chyle-
essence mixed with blood, and that the circulation of the chyle so far as it was held to contribute
its quota to the constituent elements and tissues
of the body was really supposed to be identical
with the circulation of the blood (तसी रक्तमाडाव माडावति). This will be abundantly clear from the
following account of the course of the chyle and the
blood :—

सतः वारमूतवाहाररसम् ही आबो भवतः। सतः दुष्कर...
सतः दूषो भावः पाचणायुक्ता देरिती चमनीलार्वेष अरीरारचक्षम
रक्तम् आमः वद्धत् द्वोहृष्टं यता तेज एव लिखितो भवति।
सतः वास्तव-रक्तवाती एव निष्ठति।.....सतः वारमूतम् वाहार-
रसम् ही आबो भवतः। सतः दुष्कर। दूषो भावी रक्त-
वाक्षम् वित्तेन रक्तोऽतः अरीरारचक्षम् रसं पौष्टवम् वास्तवायुक्ता
देरितो चमनीलिः उच्चरम् उच्चरारीरचक्षमि उच्चिराचि तुच्छाति।
यदः दूषी भावः वास्तवायुक्ता देरितो चमनीलिः विरामित
अरीरारचक्षाचि मात्राति वाति। et seq.

This finer essence of chyle which nourishes the flesh must also be carried in the blood, on the 'irrigation channel' hypothesis (क्षेत्रीयान्वय). (For diagrams of the central circulation and the sympathetic-spinal nervous system, *vide* my Paper on Hindu Anatomy and Physiology. The mechanism of life and the inheritance of specific and other congenital characters are also dealt with in the same paper).

Formation of molecular qualities in chemical compounds:—The Charaka school, which, we have seen, was an offshoot of the Sāṅkhyā (cf. Charaka, Vimānasthāna, Chapt. 8, यता विद्युः प्राणात् तता विद्युत्प्रवाहं प्रकाशनमिति) supplemented the above account of inorganic and organic compounds with a characteristically Sāṅkhyā explanation of the formation of molecular qualities by chemical combination. In Charaka's view, the colours, tastes, etc. of the molecules of chemical compounds result from the collocation in unequal proportion and unstable equilibrium of the different forces latent in the atoms (Paramāṇus) themselves. (एषमेतेषां एषानां पट्टवस्तुपपत्तिं चूनातिरिक्तिरेषात् मणामूर्तानां। मृतानामिव ज्ञायरक्षानानां नामास्त्वांडति-रितेषाः। Charaka.)

Chemistry of colours.—As an interesting example of the way in which a follower of Charaka would account for the colours of chemical compounds, I may note the explanation given by the late Gangadhara Kaviraja Kaviratna in the Jalpakalpataru, a commentary on the Charaka-Sambhita, published at Calcutta in 1869, premising that the Kaviraja's view is pure and genuine Charaka doctrine. Gangadhara begins with a simple statement. The qualities of the atom, he writes, tend to produce similar qualities in the molecule. A molecular quality is therefore the result of the conjunction or opposition, as the case may be, of the atomic tendencies. When, for example, the five Bhutas combine to produce an organic compound (the human body), Tejas, Ap and Earth tend to produce red, white and black respectively, but in the body (compound substance) the yellow colour may happen to be produced as the result of these tendencies in that particular proportion and collocation. The point to note here is that the molecule forms a fresh collocation, redistributes the Mass and Energy, and sets up new forces in the system which coming into play modify the potencies (or tendencies) in the component atoms and thus determine the resultant. This is elaborated into a curious but complete theory of the colours of chemical compounds.

The colours (and other qualities) of a simple substance (an isomeric mode of any Bhûta) are the result of the potencies lodged in that particular collocation of Mass, Energy and Essence. Now when two such substances unite, their colours etc. tend to be produced, but the combination brings on a fresh distribution of Energy, Mass and Essence, and the forces thus set free may powerfully modify or even extinguish the separate tendencies or potencies of the component simple substances. For example, when we prepare a collyrium by mixing equal parts of sulphur and mercury (the black sulphide of mercury), we find the resulting compound black. To explain this, it has to be remembered that each of the substances (sulphur and mercury), contains Sattva (Essence), Rajas (Energy) and Tamas (Mass) in different proportions, and that predominant Tamas (Inertia, Mass) always produces black, predominant Sattva (Essence) white and predominant Rajas (Energy) red. Now in the black sulphide of mercury, the white of the mercury tends to produce white and the yellow of the sulphur yellow ; and if these tendencies were not obstructed, the result would be a mixed colour. But, in the particular collocation in question, the Tamas of the mercury becomes intensive (शक्ति॒), and the black of the now intensive Tamas

extinguishes the white in the uncompounded mercury, which was due to prevailing Sattva, as well as the yellow of the uncompounded sulphur, which was due to the combined operation of white-producing Sattva and red-producing Rajas. Again, when, with proper apparatus and by the application of heat, we combine mercury and sulphur to produce the red sulphide of mercury, the resulting colour is explained by the fact that in this new collocation the Rajas (Energy)—probably of the mercury, though Gaṅgādhara does not specify—becomes intensive (मूल), and extinguishing both the white-producing Sattva of the mercury and the yellow-producing Sattva-Rajas of the sulphur, imparts a red colour to the compound. In these cases, as also in the formation of red by mixing powdered turmeric with lime, i.e., whenever a new colour is produced in the compound it is to be explained by the dominance of Tamas, Rajas or Sattva, or their combinations, and the extinction of the uncompounded tendencies (or potencies) by the forces set free in the new collocation. But there are other cases where the colour of the compound is a mixed colour resulting from the colours of the combining substances, e.g., when sulphide of mercury and calcined tin are mixed, the resulting colour is evidently a mixed one (Pūṣala, pink), which is

easily explained by the colours of the component elements (the red of the sulphide of mercury and the white of the calcined tin). In the same way, in a mechanical aggregate, as in a piece of cloth, the colour is white, where the threads are white.

(तत्कालीने पुष्टिवादिहमायकामुदा वस्त्रादः रुद्र चक्र-
वातोर्बं वस्त्रविशेषादिर्बं चारभ्यामात्रः उदारभ्यामात्रं वस्त्रविशेषातीर्बं
चार्ये चारभ्यामात्रं चारभ्यामात्रं चहारादिस्तं गुणात्रं उभयामा-
त्रुविशेषं इता तुविशेषं न इता लक्षातीर्बं गुणविशेषं चारभ्यामे।
इया पारदद्यवद्यात्रोः संखोर्वे वस्त्रवीद्युक्तद्वे पारदद्यात्रः इतः यज्ञ-
विशेषं चारभ्यामात्रः वस्त्रवल्लपोतः शीतलारभ्यामात्रः पारदद्यात्रोत्तरं न
तैर्व्यामारभ्यामात्रेन विशेषिना वधते। लक्ष्येष श्रीकां वस्त्रगुणात्रोनिक्षे-
णमोगुणात्रोनिक्षेन तैर्व्यात्रेन विशेषिना वधते। वस्त्रवल्लपोतको च
श्रीहितद्वात्रो इतःसत्त्वात्रोनिक्षो वधते। तदीः यज्ञवीहितद्वात्रे तैर्व्या-
समाप्तशीक्षिः इतः चमिक्षव्यते। इति पारदद्यवल्लपोतयाम्यात्रे चार्ये
गुणपौत्रमेष्वनेन वस्त्राभ्यामात्रं चार्ये वद्यते तत्त्वं तीक्ष्णद्वेष वधते,
तत्कार्यं इत्यक्षीहितं इत्या। एवं हितुषु पारदद्यवल्लपोतामारभ्यामात्रे
वस्त्रविशेषं श्रीकां वस्त्रामे रवीयद्युक्तश्रीविशेषं शीर्षेन लक्ष्यत्वां-
क्षोनिक्षो इत्यक्षीहितं वधते। पारदद्यवल्लपोतमेष्वनेन लक्ष्याभ्यामात्रं
चार्ये वधते च वधते। रश्रीविशेषस्त्रोहितं च चारभ्यामात्रे इति।
एवं हरिद्रात्मुद्दुर्लभीतेऽपि श्रीहितं चमिक्षव्यते चूर्ध्वस्त्रेष्वनेन हरिद्रात्म-
स्त्रात्मव्यवधि। एव चवधे वस्त्रा—हितुष्वद्यवल्लपोतव्येष्वश्रीहित-
व्यवधेष उभयामात्रं वस्त्रविशेषं पारदद्यव्यते, न च वह हितुष्वद्य-

कोहिंच' वहामवाहं शीता' ए कैमापि वाहते। एवं चलत्व-
निर्वितपटम् शीतामिव।) (Jalpakalpataru, Sūtrasthāna-
of Charaka, pp. 198-200; edition published
by Bhubanachandra Basak, Calcutta, Samvید-
ratorikara Press, Samvat 1925.) This is quite
in a line with Charaka's explanation of the tastes
of chemical compounds which has been already
noticed.

Parinama-vāda versus A'rambha-vāda : Charaka's
view of the formation of a new quality or a new
substance is based on the Sāṅkhya teaching as to
the conservation and transformation of Energy,
and brings chemical synthesis in a line with
evolutionary change (परिवाप). On this view, a
new substance may arise by spontaneous or inno-
rio change, i.e., by the inter-play of Energies within
the system of any given substance, in the absence
of any action from without. New qualities like
new substances are only readjustments of the
old, and continual changes are going on by
spontaneous disintegration and recombination.
Opposed to this evolutional view of chemical
synthesis is the Nyāya-Vaisesika doctrine of
A'rambha-vāda, according to which no change of
substance or quality, no effect, in short, can take

place except by the action of one component element (substance or quality) on another. A binary molecule, for example, cannot possess any 'specific quality' (विशेषता) of a kind not represented in each of the two component atoms. In the cosmic process, no atom can exist free and uncombined with another atom, and every 'specific quality' in a substance can be ultimately analysed into the union of two 'specific qualities' of the same class in two ultimate particles which cannot be further divided. A single colour, smell or taste in a single particle, until it can link itself on to another specific quality of its own class in a second particle, cannot characterise any substance formed by the union of these particles as material causes. Hence an Earth-atom cannot unite with an Ap-atom, to form a new substance of which both the particles must be equally regarded as material causes. At any rate, such a compound, if effected, would be smell-less, as of the two constituent atoms, only one, viz. the Earth-atom, possesses smell. A compound of Earth and Vāyu would be smell-less, colourless and tasteless, and so on. The Nyāya-Vaisesika does not deny that there may be compounds of different Rūpas, nor does it deny the causal operation of specific qualities as efficient or energising (dynamic) causes (उपरचक, विभिन्नात्म) but it refuses to place

these compounds on the same footing as compounds of isomeric modes of the same Bhūta ; and it accepts the 'material' causality, in such cases of only one of the Bhūtas, regarding the others as 'co-efficients' (विविजकारक).

The earlier Sāṅkhyas including the medical schools of ancient India brushed all this aside as a distinction without a difference. The Vedantists, as we shall presently see, flouted this doctrine of A'rambha-vāda. The Jainas, in opposing this Vaiśeshika view of atomic combination, hit upon a solution of the problem of chemical affinity. Others again, found out a *via media*. They held, as we learn from the reports of Udyotakara in the Nyāya-vārtikas, and of Vāchaspati Miśra in the Tātparyyaśikā, that a molecule of the structure EA (one atom of Earth and one of Ap) would exhibit some variety of colour and taste resulting from the joint action of the atoms and of their several colours and tastes. But as in the combination EA only the Earth-atom possesses smell, and the Ap-atom is smell-less, and as moreover no quality in a compound substance can result except from the joint action of the similar (potential) qualities of at least two component elements, it follows that a molecule of the structure EA would not manifest the energy of smell potentially contained in the Earth-atom.

Hence, admitting the combination EA for a smell-less compound, the upholders of this view would suppose a molecule of the type E, A (i. e. two atoms of Earth and one of Ap) to explain any bi-Bhantic compound of Earth and Ap (like the plant saps and fruit juices) which exhibits smell in addition to the peculiarities of colour and taste. (Cf. Vácha-pati's comment on Udyotyka's refutation of this view :—

४८५
वद्यमिहितः । एविद्यापरमाणुं तात्रेकं वाचुक्षमारभ्यु-
भृतः तद्वा॒ उपरथ्यांश्चलेन तदारथ्यांश्चै चापि वस्त्रस्ता-
मादप्यहात् । परं पार्थिवाणुं तद्वेद्यम् वस्त्रम् एकलेन वाचारय-
हतात् लापि पार्थिवपरमाणुष्ट्वं एकर् पार्थिवपरमाणुः ॥६१
वद्यमारभ्यांश्चै वस्त्रस्तोदप्यति इति वाच्यतः । परमाणुर्मा वहना
वाचारयहतात् । तद्वाहि वद्यः परमाणुः च वाच्यमारभ्यांशे ।)

Measures of Time and Space. Size of atoms.

The Siddhánta-Siromani gives the following measures of Time :—

30 Kshanas = 1 day, 2 Ghatikas = 1 Kshana,
 30 Kalás = 1 Ghatika, 30 Káshthás = 1 Kali,
 18 Nimeshas = 1 Káshtha, 30 Tatparas =
 1 Nimesha, and 100 Trutis = 1 Tatpara.

This makes a Truti of time equal to $\frac{1}{3375}$ of a second, which is nearly the measure of

the Paramānu of time; as given in the Vishnupurāna (vide Bhāskara's Siddhānta-Siromani—सिद्धान्तसिरोमणि) !

The above measures were in use among the astronomers, but the physicists computed according to the following table given both in Udayana's Kiranāvali and Śrīibara's Nyāyakandali :— 30 Muhūrtas = 1 day (24 hours), 30 Kālīs = 1 Muhūrta, 30 Kāshthas = 1 Kāla, 18 Nimeshas = 1 Kāshtha, 2 Lavae = 1 Nimesha, 2 Kshanas = 1 Lava.

वर्षार्थ तदः प्राप्ता विमित्यु वर्षादयम् ।

प्राप्तार्थनिमित्यु काला विमित्यु ताः कालाः ।

विमित्युकाला दुइः सत्रूपं विमित्युपाकृष्टी एते ।

(Udayana, Kiranāvali).

This makes 1 Kshana of the Nyāya-Vaisesicika equal to $\frac{1}{72}$ of a second. The Nyāya assumes that the unit of physical change (or the time occupied by any single antecedent step in a causal series before the succeeding step is ushered in) is equal to a Kshana (or $\frac{1}{72}$ of a second). The astronomers were familiar with far smaller measures of time. The astronomical Truti of time measures about the thirty-four-thousandth part of a second. This is of special value in determining the exact character of Bhāskara's claim to be regarded as the precursor of Newton in the discovery of the principle of the Differential Cal-

culus, as well as in its application to astronomical problems and computations. This claim, as I proceed to show, is absolutely established ; it is indeed far stronger than Archimedes's to the conception of a rudimentary process of Integration. Bhāskara in computing the "instantaneous motion" (सामान्यकी वेगः) of a planet compares its successive positions, and regards its motion as constant during the interval (which of course cannot be greater than a Truti of time, though it may be indefinitely less). This titkālika motion is no other than the differentia of the planet's longitude, and Bāpudeva Sāstrī claims that both the conception of the instantaneous motion and the method of determining it plainly show that Bhāskara was acquainted with the principle of the Differential Calculus. On the data before him, Mr. Spottiswoode remarks that Bāpudeva Sāstrī "overstates the case." Bhāskara "makes no allusion to one of the most essential features of the Differential Calculus, viz., the infinitesimal magnitude of the intervals of time and space therein employed. Nor indeed is anything specifically said about the fact that the method is an approximate one." "With all these reservations" Mr. Spottiswoode continues, "it must be admitted that the formula he establishes and the method of establishing it

bear a strong analogy to the corresponding process in modern mathematical astronomy" (*viz.*, the determination of the differential of the planet's longitude,—by no means the first step in transcendental analysis or in its application to astronomy). And Mr. Spottiswoode concludes by stating that mathematicians in Europe will be surprised to learn of the existence of such a process in the age of Bhāskara (*circa* 1150 A. D.—born 1114 A. D.). Mr. Spottiswoode's second objection that Bhāskara does not specifically state that the method of the Calculus is only approximative cannot be taken seriously. The conception of limit and the computation of errors came late in the history of the Calculuses of Fluxions and Infinitesimals. For the rest, Bhāskara introduces his computation expressly as a "correction" of Brahmagupta's rough simplification. The first objection (*viz.*, that Bhāskara makes no allusion to the infinitesimal magnitude of the intervals of space and time employed) would be more to the point, if it were well founded. But it is not, and Mr. Spottiswoode's error was due to the insufficiency of the data supplied to him. As a matter of fact, even Bhāskara's unit, the Truti of time (or Paramānu), is exceedingly small as the very name implies, being about one thirty-four-thousandth of a second of time. And in the passage in which Bhāskara describes the process, he distinguishes

between Sthūla-gati and Sūkshma-gati (velocity roughly measured, and measured accurately i.e., by reference to indefinitely small quantities, for Sūkshma, as we have seen, has always a reference to the Anu, the indefinitely small). Indeed he expressly mentions that the Sthūla-gati takes only Sthūla-kāla (finite time) into consideration, and that the determination of the Tātkalikī Gati (Sūkshma-gati) must have reference to the moment (मूलिकम्), which is an indefinitely small quantity of time being of course smaller than his unit, the Truti. (Cf. एवं विष्णु सूक्ष्मा गतिः परं सूक्ष्मा तात्प्राचिकी वर्णते..... यदा चारुकलित्यकालदा तात्प्राचिक्या वर्णा तिविदावत्तं चर्तुः तु अते । तथा सूक्ष्मीप्रचारवस्था । यदा तु दूरतरक्षित्यकः दूरत्यावत्तं वा चक्रव तदा चारुका चर्तुः तु अते । चर्तुः कालवान् । दत्तवद्वयतिः वर्णनान् इतिवर्तं तथा वा अर्थात् चतुर्वर्षे एवं विजेतीर्णितिः ;—nothing can be clearer than this conception of 'momentary' motion.—Bhāskara, Siddhānta-Siromani, Ganitādhyāya, Gatisphutiprakarana : cf. also इतिवर्तं वा व वनः वर्णनः, ibid., cf. also Golādhyāya, Tātkalikī-karana-vicāra-prakarana, where Bhāskara points out that the mode of computing adopted by the Āchārya (Brāhma-gupta) is a rough simplification. The computation of relative motion and the idea of resolved components of motion were of course familiar to

the astronomers.—(Cf. एवं गोपालेन्द्र वाचपाते रहस्यो-
कल्पिती अनुष्ठान वर्णेत्वमः; ibid.) I may add en
passant that Bhāskara's formula for the computation
of a table of Sines also implies his use of the
principle of the Differential Calculus.

Measures of weight and capacity. The Amara-
koṣha mentions measures of three kinds—weight,
length and capacity (लाभ गतिशीलता तथा).

The Krishnala (Guṇja, Raktikā, the black and
red berry of the Shrub Abrus Precatorius) was
employed as a natural measure of weight. 80
Krishnala berries on the average weigh 105 grains
Troy, and this must be taken as the basis of our
computation, though in current practice 80 Krish-
nalas are taken to be equivalent to 210 grains.
One Krishnala was supposed to weigh as much as
3 medium-sized barley seeds (जूरदार), one of
the latter as much as 6 white mustard seeds
(मौरसदार), one white mustard as much as 3 Raji
mustard seeds (राजिसदार), one of these seeds as much
as 3 Likhas, and one Liksha as much as 8 Rajas
or Trasarenus.

We now come to conventional measures. One
gold Mūshī was the weight of 5 Krishnalas of
gold, 1 Suvarna or Tola weighed as much as 16
Mūshīs, and one Pala as much as 4 Suvarnas or
Tolis. A Pala of gold therefore weighs 320 Krish-
nalas (Manu, Chap. VIII, Vishnu, Chap. IV, and
Yājñavalkya, Chap. I).

A Māshā of gold therefore would weigh 6 $\frac{1}{2}$ grains; a Toli, 105 grains (in current practice it weighs nearly double as I have stated); and a Pala, 420 grains Troy.

The measures for silver were the following:—
1 Silver Māshā = 2 Krishnals, 1 Dharana = 16 Silver Māshás and 1 Pala = 10 Dharaṇas. A Pala of silver would therefore weigh 320 Krishnals. In other words, the Pala was a fixed measure of weight, and was equal to about 420 grains Troy, or double this, if we take the Krishnala of current practice.

A Pala, which equals 320 Krishnals, was subdivided by 4, 16 and 5 successively for gold, and by 10, 16 and 2 successively for silver. A Savarna (or Tolá) of gold corresponds roughly to a Dharana of silver, and a gold Māshá to a silver Māshá, but the sizes (or volumes) are not the same, and we must not therefore conclude that gold was supposed to be heavier than silver in the proportion of 5 to 2.

We find that 1296 Trasarenus equal 1 Krishnala. A Trasarenu, as a measure of weight, therefore, is the equivalent of $5\frac{1}{2}$ of a grain Troy or double this according to current measures.

But the Trasarenu of physics is a different conception. It stands for the minimum visible, i.e., as the physicists define it, that which is just discernible as a glancing particle in the slan-

ting beams of the morning (or afternoon) sun, coming into dark room through a chink or orifice of a window. This is a measure of size (or rather stimulus limen).

Measures of Capacity. Here the standard was furnished by the Kudava (குடாவ), a vessel described as 3 Āngulis long, 3 Āngulis broad, and 1½ Ānguli deep,—with a cubical capacity of 13½ cubical Āngulis. 4 Kudavas = 1 Prastha, 4 Prasthas = 1 A'dhaka, 4 A'dhakas = 1 Drona, and 4 drosses = 1 Khāri or Bhāra.

24 Āngulis make 1 Hasta, cubit, which may be taken to be 18 or 19 inches. A Kudava was divided into 4 Palas, and there can be no doubt that originally water of the weight of 4 Palas was found to be actually contained in a vessel of the cubical capacity of a Kudava. If we take the ancient cubit to have been 19 inches, the Kudava would contain nearly 4 Palas of distilled water at 30 Centigrade. On a cubit of 18 inches, the Kudava would contain about 3½ Palas.

The Kudava in current medical practice is supposed to represent a cubical vessel, each side being 4 Āngulis. This would give a capacity of 27 cubic inches, if we take the modern cubit of 18 inches. The Kavirājas take a Kudava to contain 8 Palas of water, and as 1 Pala = 320 Krishnas, and 80 Krishnas are now taken to be equal to 210 grains Troy, a vessel of a capacity

of 27 cubic inches is accordingly supposed to contain about 6720 grains Troy,—which is not very wide of the mark, being about 1·8 per cent short for distilled water at 86° Fahrenheit or 30° centigrade.

Size of the minimum visible; size of an atom.

The supposed thickness of the just discernible mote in the sunbeam called a Paramānu in Technology, Silpa-śāstra, (and a Trasarenu in Natural Philosophy, follows directly from Varāhamihira's table :—8 Paramānus make 1 Rajas (or Ratharenu,—cp. the Mānasāra), 8 Rajas make 1 Balāgra (filament of hair), 8 Balāgras make 1 Liksbā, 8 Liksbās make 1 Yūkā, 8 Yūkās make 1 Yava, 8 Yavas (the Mānasāra has 4) make 1 Anguli (superior), 24 Angulis make 1 Hasta (cubit, lesser cubit, 18 inches). The thickness of the minimum visible (the finest perceptible mote in the slanting sunbeam) is therefore taken to be $3.2 \cdot 10^{-10}$ or $3.2 \cdot 10^{-11}$ of an inch. The volume of a spherical Trasarenu (or Paramānu of the Silpa-śāstra) would therefore be $\frac{4}{3} \pi 3.2 \cdot 10^{-11}$ of a cubic inch. It may be here noted that such a Trasarenu is supposed in the medical schools to contain 30 chemical atoms (Paramānus of Natural Philosophy) according to one estimate, or 60 according to another. The size of an atom must then have been conceived to be less than $\pi 3.5 \cdot 10^{-11} \cdot 2^{-10}$ of a cubic inch.

परमानुस्त्रियाकादलिपद्वयं यतोऽनुसं चेति चक्रवृत्तानि वर्णीतरम् एष

वैद्य व्याधि उच्चः—Varahamihira, Vṛihatśāmbhita, chap. 57. Sloka 2—आत्माकरमनि भानो वस्त्रपत्रं दानं रजो वाति
विद्याम् परमाणुं वस्त्रं तदि प्रभावानाम्। ibid., Sloka I.—Cf.
Utpala. तत्परमाणुं भानं इमाणुं जागीरात्। इमावानो लक्ष्य
वस्त्रं वस्त्रमाणुं इमाणुं परमाणुं उच्चम्। Cf. also, वस्त्रेण्यु
विद्येः विद्या परमाणुम्।

The magnitude of a Paramānu is called Pārimāndalya (पारिमांदल्य) in the Nyāya-Vaisesika, the name suggesting that the Paramānus were conceived to be spherical in shape. The Nyāya-Vaisesika calls a Paramānu a mere point without any dimensions, but in the Śāṅkhya-Patañjala, a Paramānu, though indefinitely small, had still dimensions, being divisible into Tanmātras, which were themselves integrations of Bhūtādi. The diameter of a spherical Paramānu must have been conceived to be less than 3.2^{-10} of an inch (i.e. less than the conventional Paramānu with which linear measures begin), and the volume of a Paramānu would therefore, in accordance with Bhāskara's formula, be smaller than $\frac{4}{3}\pi 3.2^{-13}$ or $\pi 3^2.2^{-11}$ of a cubic inch where $\pi = \frac{22}{7}$. The Tanmātras were conceived as smaller still.

That these were conventional measures arbitrarily assumed goes without question, for, of course, the Hindus had no physical data for a mathematical calculation of these minute quantities. A Balāgra (hair-tip, or finest filament of hair), for example, is taken to be 3.2^{-11} of an inch

thick, i.e. less than one five-thousandth fraction of an inch in thickness; and a fibril of the networks of Dhāmanī or Nādi (nerve) that supply the pores of the skin (papillæ ? सुक्तानि रोमकृपतिश्वासि, *Susruta*) was supposed to be about a thousandth part of the finest hair in thickness, or $\frac{1}{10^3}$ of the 'minimum visible', and therefore about $3 \cdot 10^{-12} \text{ in.}$ of an inch thick (cf. द्रुक्षाकृपालकारः परेषः कदम्बमादेन तुक्तात् परार्थि, *Pañchadasī*), but it is evident that these measures were arbitrarily fixed upon, instead of being arrived at by calculation or actual measurement. Indeed, Charaka expressly states that the number of Siras and Dhāmanis in the body (three million fifty-six thousand nine hundred) is only a conjectural estimate एवं चक्षनः पर दर्शने—*Sáriṇasthāna*, Chap. VII).

My account of the chemistry of the Sāṅkhyā-Patañjala, and of the affiliated Yoga and medical schools, has anticipated in several points the views of the Vedānta and the Nyāya-Vaisesika. The chemical facts, processes and apparatus are indeed common to all the schools. In the following account of the chemistry of the schools other than the Sāṅkhyā Patañjala, I will confine myself to the theory of the subject, and even of this I will attempt only the briefest outline.

The Vedāntic view :—

The Vedāntists believe Māyā to be the 'material cause' (उपादानकारी) of the world. The power

of Māyā is the power to realise the unreal—to impart practical Reality or mediate existence to that which does not and cannot possess absolute Reality or self-existence. Māyā is at once real and unreal, while the Brahma (Self) is absolute Reality, absolute Intelligence and absolute Bliss. The world evolves out of Māyā (मायापरिवार) so that Māyā in the Vedānta replaces the Prakṛiti of the Sāṃkhya. But Māyā, and by implication the world, originate out of Brahma, not by a process of evolution (परिवार), but of Vivarta (self-alienation). The self-alienation of the Absolute, acting through Māyā, produces in the beginning Akāsa, one, infinite, ubiquitous, imponderable, inert and all pervasive. The world thus begun goes on evolving, in increasing complexity. The other Sūkṣma Bhūtas, classes of subtle matter, evolve from Akāsa, in an ascending linear order.—Akāsa giving off Vāyu. Vāyu giving off Tejas, Tejas giving off Ap, and Ap giving off Earth. Akāsa, one, infinite, all-pervasive, has the capacity of sound. Vāyu, subtle gaseous matter, emanates from the universal Akāsa and is instinct with the potential of mechanical energy (impact, pressure). वृत्त, रसायन, पट्टन, घट्टन—वाकीष विद्वान्मनोराजिनः—विद्वान्मनोराजिनः—Vidvanmanorajini).

Tejas, subtle radiant matter, emanates from Vāyu, and contains in potentia the energy of light and heat. Ap, subtle viscous matter, is the

transformation of Tejas, and is instinct with the energy that stimulates the nerve of taste, and lastly, Earth, subtle hard matter, which is the transformation of Ap, possesses the latent energy of smell.

But the subtle rudiments of matter must be compounded in various ways, to give rise to the gross constituent matter of the world. These forms of gross matter are called Mahābhūtas. There are five kinds of Mahābhūta (gross matter corresponding to the five Sūkshma Bhūtas (subtile matter, and the process by which a Mahābhūta is produced from the Sūkshma Bhūtas is called Pañchikarana (quintuplication). All the five Sūkshma Bhūtas are present as ingredients, though in different proportions, in each Mahābhūta.

The Mahābhūta Earth, gross earth-matter, is composed of four parts of subtile earth-matter, and one part each of the other forms of subtile matter. The Mahābhūta Vāyu is composed of four parts of subtile gaseous matter and one part each of the other forms of subtile matter. And similarly with other Mahābhūtas.

Hence if a_k , v , t , ap , e , represent the five forms of subtile matter (Akasa, Vāyu, Tejas, Ap and Earth), and A_k , V , T , AP , E , stand for the corresponding Mahābhūtas, we may represent the constitution of the Mahābhūtas as follows :—

$AK = ak_4 \cdot (v_1, t_1, ap_1, e_1)$, ak_4 being the radicle.

$V = v_4 \cdot (ak_1, t_1, ap_1, e_1)$, v_4 being the radicle.

$T = t_4 \cdot (ak_1, v_1, ap_1, e_1)$, t_4 , being the radicle.

$AP = ap_4 \cdot (ak_1, v_1, t_1, e_1)$, ap_4 being the radicle

$E = e_4 \cdot (ak_1, v_1, t_1, ap_1)$, e_4 being the radicle.

In forms of gross or compounded matter, the potential energies (or qualities) become actualised. The Mahābhūta Akāsa manifests sound; Vāyu, sound and mechanical energy; Tejas, sound, mechanical energy and heat-light; Ap, the energy of the taste-stimulus in addition; and finally Earth the energy of the smell-stimulus added to the foregoing.

The Pañchadasī characterises the different Mahābhūtas by their typical sounds; e.g., Akāsa by the echo (hollow booming sound); Vāyu (air) by a sibilant sound, hissing, susurration (imitative symbol, Visi); Tejas (fire) by a puffing (or roaring) sound (imitative symbol, Bhugubbagu); Ap (water) by a liquid sound (imitative symbol Culu Culu, gurgle, plash-plash, glut-glut); and finally Earth by a splitting or rattling sound, a crack or a thud (symbol, kad-kada)—Chap. II. Bhūtaviveka, S'loka 3, Pañchadasī, cf. also Jayanta, Mañjari.)

Others hold that Akāsa, Ether, never enters as a component part, and is always one and indivisible. In this view, the four Mahābhūtas—Vāyu, Tejas, Ap and Earth alone are supposed to be com-

pounded, and by a process which may be called quaternion (cf. the Neo-Platonist quaternion) :—

$$V = v_3 (t_1, ap_1, e_1)$$

$$T = t_3 (v_1, ap_1, e_1)$$

$$AP = ap_3 (v_1, t_1, e_1)$$

$$E = e_3 (v_1, t_1, ap_1)$$

These compound forms, as before, are supposed to exercise their specific energies actively. Others again hold that the Mahabhutas—Tejas, Ap and Earth alone are compounded by a process named Trivrit-karana (triplication). Thus $T = t_1 (ap_1, e_1)$, $AP = ap_1 (t_1, e_1)$, $E = e_1 (t_1, ap_1)$.

The Sūkshma-bhutas are forms of homogeneous and continuous matter, without any atomicity of structure ; the Mahabhutas are composite ; but even these are regarded as continuous, and without any atomic structure. The Vedānta speaks of Anu (Paramānu) not as an ultimate indivisible discrete constituent of matter, but as the smallest conceivable quantum or measure of matter. In the Sāukhya doctrine, the atomic structure is ordinarily accepted. The Gunas are supposed to be अशेष and अविभाग्य bonded and indefinitely small in size (except the Gunas giving rise to A'kāra and Manas which are unlimited अशेष) ; and hence the Tanmātras and Paramāṇus must be conceived to have a discrete structure.

As I have already noted in my account of the genesis of Tanmātras and Paramāṇus, various

schools of Vedāntists (e.g. the Rāmānujists and the followers of Nimbārka) combined, in the orthodox fashion of the Smritis and the Purāṇas, the Vedāntic theosophy with the Sāṅkhya cosmology especially as regards Prakṛiti and the order of creation and dissolution. For example, the Vedāntakaustubhaprabhā, fortifying itself with texts from the Viṣṇu Purāṇa and the Subala and Gopala Upanishadas, contends that at the cosmic dissolution (Pralaya), each Mahābhūta merges into the one that preceded it in the order of creation by first disintergrating into its own proper Tanmātric form (तन्मात्रा), and that the Mahābhūta A'kasa merges into the original Tanmātrus, which then lapse into Bhūtādi, the supersubtile rudiment matter, proto-matter (Chap. II, Pada 3 Sutra 14).

Parināma—Evolutionary Process:—When the Mahābhūtas are once formed, the different kinds of substance are derived from them by the evolutionary process called Parināma (परिनाम, transformation). Matter is constantly undergoing change of state. The effect is only the cause in a new collocation (कारणस्य उत्तमसाध्यं कार्यम्). Change is of two kinds :—

(1) Change by a spontaneous process, without external influence, including isomeric change (कार्यात्मिक परिवर्तनम्). The Vedāntists believe in

spontaneous disintegration and reintegration. Action from without, impressed force *ab extra*, is not, *pace* the Naiyāyikas, always a condition of change of state (whether of rest or of motion);— nor is it necessary that more than one substance should combine to generate another substance or variety of substance (e. g. the formation of curds from milk, of ice from water etc.). All this is directed against the Nyāya doctrine (A'rambhavāda).

(2) Change due to combination with other substances (अन्तरसंबोध). Such combination may produce (1) a compound substance possessing like qualities with the constituents (समानजातीयपूर्वि), or (2) unlike compounds with new qualities, "heteropathic effects" (विकारीयोपूर्वि). Any new quality thus evolved through (chemical) combination is called *Sambhata-bhūta-dharma* (संभूताधर्म), e. g. the intoxicating power of the fermented rice and molasses, which does not exist in the ingredients taken separately. (नियोगीकारी शब्देषु च इत्यासाधि द्वयाद्वयता नहवतः हस्ते) This *Sambhuyakriyā* (संभूतक्रिया, उभयात्र) corresponds to chemical combination, and the Vedantists, like the Sāṅkhya, explain this only as the evolution of the latent energy (अविद्या, अवृत्तताविद्या) in a new collocation (संस्थापन, चरणस्थ-स्थिरितम्). But, unlike the medieval Sāṅkhya, the Vedānta freely recognises the com-

bination of heterogeneous Bhūtas. Thus, Earth, Ap, Tejas and Vāyu freely combine in different proportions and groupings to produce the variety of substances in the world. For example, the animal organism is a compound of all the five Bhūtas (प्रमाणित). It is not merely the concomitant or efficient causes that may be heterogeneous to the material cause, as the Naiyāyikas contend, but several heterogeneous substances or (Bhūtas) may unite as 'material causes' to produce a new substance.

The Vedantists resolve all activity, physical, vital as well as psychical, into modes of motion, subtle cosmic motion (परिक्रमा, संक्षेपितपरिक्रमा—Sāṅkara ; वायुः परिक्रमानवलाभः—प्राणम् परिक्रमानवलादिः—यह तं सूक्ष्म शूष्म ए तत्त्वं वस्त्रःपरिक्रमानवल—Sāṅkara); but they give a separate substantive existence to the agents, the vital principle (जीव) and the mind (मनः), though these are also evolutionary transformations of the Sūkshma Bhūtas (forms of subtle matter). What is common to the Nyāya, the Vedanta and the Sāṅkhya is that Consciousness or Intelligence (चेतना) transcends Matter; but the Naiyāyikas as pluralists hold that vital and psychical activities are also immaterial and cannot be resolved into motion (परिक्रमा);—the Vedantists resolve these activities into subtle motion, but

ascribe them to a substantive quasi-material Life Principle and Mind, the all-mirroring Intelligence (चेतना) alone being immaterial and transcendental : and the Sāṅkhyas accept the substantive existence of the Mind principle (मनः) as derived co-ordinately with the Sūkshma Bhūtas or Tanmātras from individualised prakṛiti (Ahaṅkāra), but resolve Life into a mere resultant activity of the bodily organs, viz. the organs of sense and movement, and the psychic principle (मनः).

पौरीवरण :—हिता विशाद् चैकेऽन्तं चतुर्वाँ इत्यत्र पुनः ।
ज्ञानेवरदितीवैष्णोवनात् पञ्च पञ्चते ।

विद्वान् तु ती ब्रह्माणा मूर्ताणा चक्षुतरज्ज्वरहारमहरपद वरभी-
पादतवा विहृतवरेण तु त तदन् भूतपदवद्वर्त्तु चयि तथा । तदानीं
पश्चीवरवान्नर चाकाश चक्षुदीर्घिक्ष्वाने चक्षुतवैति वर्णं वीक्षनीयं
(विद्वन्मनोऽविभौ)—चक्षि हि ग्रोरे वर्णं वामपि मूर्ताणा चार्य-
लोकिपतिः चक्षुतवैहनपदमहेदग्नवादिष्वाणा वर्णं वामामुमर्हिद्वान् ।
चक्षुतवारपदया पश्चाति मूर्ताणि एवज्ञिन इह स्मृतिः क्षिति-
रुपुष्टवीरिय चक्षुतवदवित्तमेव पश्चमूतदेहयोर्युक्तं । न च वर्णं वृद्धवान्
एव इव वान् च चाकाशस चार्यलक्ष्मानुपर्यतिरिति वार्णं । चार्य-
वादम चक्षुदीकारान् । एवज्ञापि दुर्लभवदिनो दध्वारपदवद्वर्त्तान् ।
चक्षुतवृत्तं पश्चाति मूर्ताणा पश्चात्तवद्वर्त्त दर्शितवान् चार्यवादम
निराकृतवान् च । तथात् दिव्यं ग्रीरे पादवीतिक्षिति । Vidvan-
māṇorūpījīo.

न वायुम् उमानवातोवदेव चारबते व लिङ्गादेवविभिति विद्वा
वाति । उमानविकारसे एव उमानवातोवद्वाभ्युपदमः व चारकार-
विद्व इति तदैष चनेकामिषम् । नापि चनेकसेव चारबते वेविभिति
विद्वोइति । चच्छनवीरायवस्तारक्षाभ्युपदमात् । एषेषोहि परमात्म-
पाद्य चक्रवीरामते व इत्याकर्ते लंडम इत्यभ्युपदमते । इत्यार्थे एव
चनेकारकविद्व इति चेत् व वरिकानाभ्युपदमात् । वदेव तु
इत्यं विदेवददर्शकान्तरं चापयमानं कार्यं नामाभ्युपदमते । तत्र लक्षित-
चनेकं परिषद्वते वस्तीकाभ्युराहिभादेव, लक्षितेष्वं परिषद्वते चौराहि-
ददर्शकादिभादेव । वैपरमात्मनं चक्षि चनेकं एव चारेण कार्ये अभवति
इति । Sāṅkara, Sārīraka bhāṣya, Sūtra 7, Pada 3,
Adbhāya II).

The atomic theory of the Buddhists :—The Vaibhāshikas and the Sauntantikas hold that the Vāyu-atoms are touch-sensibles, having impact or pressure for their characteristic property, and by aggregation from the element Vāyu; the Tejas-atoms are colour-and-touch-sensibles, having heat for their characteristic, and by aggregation from the Tejas Bhūta; the Ap-atoms are taste-colour-and-touch-sensibles with a characteristic viscosity, and form the Ap-element by aggregation; and finally the Earth-atoms are smell-taste colour-and-touch-sensibles possessing a characteristic dryness or roughness (चरक), and by their aggregation form the Earth-element. The Bhūtas

thus originated combine to form aggregates, which are classed as inorganic substances, organisms and organs. (कामिद्वादवकोऽचुः—Udyotakara's extract from the Buddhist Sūtras, Nyāya Vārtika. Chap. I, Ābhīka 1, Sūtra, 14. cf. Vāchaspatti's fuller extract :—
 कामि वद्वादवकोऽचरणम् उपशात्रुरूपवान् : कामधातुः—also the Buddhist commentary :—कामि वामधातौ वद्वादवः पचुः। उपरस्तवत्याहा॑ चति वलारि इवाचि शब्दपैदीवान् : चति वलारि—Vāchaspatti. Tītparyyaśīka. loc. cit.—also वर्त्तेद्वादवव्यवहारानि शूकानि—vide Udyotakara, Chap. III, Ābhīka 2, Sūtra 12.—Vide also Śrīnivāsa's Vedānta-kaustubba, Chap. II, Pada 2. Sūtra 18).

The atomic theory of the Jainas :—Of the nine categories of the Jainas, that of Ajīva (the not-soul or non-Ego) consists of five entities, four of which are immaterial (अमृतं), viz., merit, demerit, space and Time, and the fifth, material (मृतं, possessing figure). The last is called Pudgala (matter), and this alone is the vehicle of Energy, which is essentially kinetic, i.e. of the nature of motion. Everything in the world of not-soul (the non-Ego) is either an entity (जड़), or a change of state in an entity (पर्याप्ति). Podgala (matter) and its changes of state (पर्याप्ति), whether of the nature of subtle motion (परिक्रमा) or of Evolution (परिवाल), must furnish the physical as opposed to the metaphysical basis of all our explanations of Nature. Pad-

gala (Matter) exists in two forms,—Anu (atom) and Skandha (aggregate). The Jainas begin with an absolutely homogeneous mass of Pudgalas, which, by differentiation (भेद) breaks up into several kinds of atoms qualitatively determined, and by differentiation, integration, and differentiation in the integrated (सम्पादन, भेदात्, समाप्तिमिहात्—Umāsvati, Chap. V, Sūtra 26), forms aggregates (Skandhas). An Anu has no parts, no beginning, middle or end. An Anu is not only infinitesimal, but also eternal and ultimate. A Skandha may vary from a binary aggregate (एषुष) to an infinitum (अवश्यक्युत). A binary Skandha is an aggregate of two Anus (atoms), a tertiary Skandha is formed by the addition of an atom (Anu) to the binary (एषुष) and so on ad infinitum. The ascending grades are (1) what can be numbered (संख्येष), (2) indefinitely large (बहुसंख्येष), (3) infinity of the first order (अवश्यक), (4) infinity of the second order (अवश्यकावश्यक), and so on.

General Properties of Matter :—

The specific characters of the Pudgalas (Matter) are of two kinds, (1) those which are found in atoms as well as in aggregates, and (2) those which are found only in aggregates. Qualities of touch, taste, smell and colour come under the first head.

The original Pudgalas being homogeneous and indeterminate, all sensible qualities, including the infra-sensible qualities of atoms, are the result of evolution (प्रवृत्ति). Every atom thus evolved possesses an infra-sensible (or potential) taste, smell and colour, (one kind of each) and two infra-sensible tactile qualities, e.g. a certain degree of roughness or smoothness (or dryness and moistness?) and of heat or cold. Earth-atoms, Ap-atoms, etc. are but differentiations of the originally homogeneous Pudgalas. The tactile qualities (त्वर, स्वर, रुद्धि, शौष्ठी) appear first, but qualities of taste, smell and colour are involved in the possession of tactile qualities. An aggregate (Skandha), whether binary, tertiary or of a higher order, possesses (in addition to touch, taste smell, and colour) the following physical characters:—(1) sound, (2) atomic linking, or mutual attraction and repulsion of atoms, (3) dimension, small or great, (4) figure, (5) divisibility, (6) opacity and casting of shadows, and (7) radiant heat and light.

Sensible qualities. Tactile qualities are of the following kinds—hardness or softness, heaviness or lightness (degrees of pressure), heat or cold, and roughness or smoothness (or dryness and viscosity?). Of these, the atoms (Atmas) possess only temperature, and degrees of roughness or smoothness, but

all the four kinds of tactile qualities in different degrees and combinations characterise aggregates of matter from the binary molecule upwards. The Jainas appear to have thought that gravity was developed in molecules as the result of atomic linking. Simple tastes are of five kinds,—bitter, pungent, astringent, acid and sweet. Salt is supposed by some to be resolvable into sweet, while others consider it as a compound taste. Smells are either pleasant or unpleasant. Mallishena notes some elementary varieties of unpleasant smell, e.g. the smell of asafoetida, ordure, &c. The simple colours are five—black, blue, red, yellow and white. Sounds may be classed as loud or faint, bass (thick) or treble (hollow), clang or articulate speech.

The most remarkable contribution of the Jainas to the atomic theory relates to their analysis of atomic linking, or the mutual attraction (or repulsion) of atoms, in the formation of molecules. The question is raised in Umasvati's Jaina Sutras (circa A. D. 40) —what constitutes atomic linking ? Is mere contact (or juxtaposition) of atoms sufficient to cause linking ? No distinction is here made between the forces that bind together atoms of the same Bhuta, and the chemical affinity of one Bhuta to another. The Jainas hold that the different classes of elementary substances (Bhutas) are all evolved from the same primordial atoms.

The intra-atomic forces which lead to the formation of chemical compounds do not therefore differ in kind from those that explain the original linking of atoms to form molecules.

Mere juxtaposition (स्थिति) is insufficient; linking of atoms or molecules must follow before a compound can be produced. The linking takes place under different conditions. Ordinarily speaking, one particle of matter (शरीर) must be negative, and other positive (विषयव्यष्टिः); the two particles must have two peculiar opposite qualities, roughness and smoothness (खल्ला and सूक्ष्मा or dryness and viscosity?), to make the linking possible. But no linking takes place, where the qualities, though opposed, are very defective or feeble (अवश्यक). We have seen that, ordinarily speaking, two homogeneous particles, i.e. both positive, or both negative, do not unite. This is the case where the opposed qualities are equal in intensity. But if the strength or intensity of the one is twice as great as that of the other, or exceeds that proportion, then even similar particles may be attracted towards each other. In every case, change of state in both the particles is supposed to be the result of this linking, and the physical characters of the aggregate depend on the nature of this linking. When particles of equal intensity (negative and positive) modify each

other, there is mutual action ; in cases of unequal intensity, the higher intensity transforms the lower, it being apparently thought that an influence proceeds from the higher to the lower. All changes in the qualities of atoms depend on this linking. A crude anticipation this, of the ionic theory of chemical combinations, very crude but immensely suggestive, and possibly based on the observed electrification of smooth and rough surfaces as the result of rubbing. The interpretation of अ॒ष्टु and तिष्ठ as dry and viscous (or as vitreous and resinous ?) must be rejected in this connection as untenable. The Tattvārthādbigama of Umāsvatī, which expounds the theory, most probably dates back to the first half of the first century A. D. Cf. Umāsvatī—Tattvādbigama, Chap. V.

(अशीरकादा चक्षोवक्षोवादपुड्याः । इत्याचि शोकाद । फिक्षा-
वस्त्रितानि चक्षपाचि । उपिष्ठः पुड्याः । आकाशादिवस्त्राचि ।
निष्क्रियाचि च । पुहमवक्षोवाद्यु तिष्ठावाः । (तिष्ठेति विषयसंग्रह) ।
वक्षेषां प्रदेशाः सर्वां चक्षेष एतमासीः । चक्षोवादक्षेषाव पुहमवाणी ।
पाषोः । अर्थरसववर्षवानः पुहमवाः । तत्र अर्जोऽप्यविष्टः लक्षणी
वद्युरुपर्षुः श्रोत उच्चः तिष्ठः वक्ष इति । एव एवविष्टविषः
कटुः चण्डीको मधुर इति । नवी तिष्ठिः तुरमिरसुरुषिः । वर्षः
एवविषः लक्षो श्रोतो शोकः शीतः वक्ष इति ।

अद्वद्वद्वलीच्छालीच्छालभेदतत्त्वावातपीयीतवद्वद । तत्र वक्षः
एवविषः ततो विततो वक्षः इवारी वक्षो भाव अत । चक्षः

चारीविद्वद्विता चति । चतोचते । चतुर्विद्वानुकः । परिचामन् ।
चताह इतीरपि कथमामयोन्युवरस्ते चति चतुर्विद्वानी भवति इति ।
चत्तेऽपि । एवे चतुर्विद्वानिष्ठौ । एवे चति चतुर्विद्वा-
नुकः परिचामनो भवति । चतिक्षुणो हीनसंति । Umārvati,
Tattvārthādbigama, Chap. V).

The Nyaya-Vaisesika chemical theory : a brief summary.

I must content myself here with a brief and rapid sketch of the chemistry of the Nyaya-Vaisesika, which I shall elaborate in connection with the mechanics and physics of the ancient Hindus in a separate paper.

The relation of the specific characters of molecules (and higher aggregates) to the original atomic qualities is reduced in the Nyāya-Vaisesika to the following canons:— (a) वार्यतुष्ट चारकमुष्ट-पूर्णतम् । (b) समानशातोवस्तुतीयः द्रव्यारचकः एव विशेषीवस्तुतीयः (Here, एव is used in a narrow technical sense, so as to exclude the quasi-compound substances). (c) चदावस्थापरवस्थापर्वपरिकारं वस्त्रेषु चारकमुष्टपूर्णतम् इति कारकमुष्टपूर्णताः । (d) उपरहवकामुष्टपर्वपरिकारेषु चारकमुष्टपूर्णताः इति कारकमुष्टपरिकाराः । No separate explanation is necessary, as the canons are embodied in the following exposition.

Theory of Atomic combination :—

The four kinds of Atoms are Earth, Ap, Tejas and Váyu atoms, possessed of characteristic mass, numerical unit, weight, fluidity (or its opposite), viscosity (or its opposite), velocity (or quantity of impressed motion—Vega); also characteristic potential colour, taste, smell or touch, not produced by the chemical operation of heat चपावः-उत्तरवद्यन्तां परिकार्त्तं च-पृथक्-युक्तवद्यन्ते हरिषाः). A'kás has no atomic structure (निरक्षय), and is absolutely inert (निषेद), being posited only as the substratum of sound, which is supposed to travel wave-like in the manifesting medium or vehicle of Váyu (air). Only the other four Bhútas unite (or disunite) in atomic or molecular forms. The orthodox view is that, the presence of Earth-atoms is necessary whenever chemical transformation under the operation of heat (गत्वा त्रैष्विति) takes place.

Atoms cannot exist in an uncombined state in Creation (Sivádityā, Sapta-padarthī—Vids commentary, where, however, it is noted that still atmospheric air is believed to be monatomic in structure, i. e. to consist of masses of atoms in a loose uncombined state—! श्वीमतवायुस्त्र चरमात्मुक्तम् १३ अनारब्दः !

The atoms may combine in one or other of the following ways :—

1. One Earth-atom, by an original tendency, unites with another, to form a binary molecule (द्वृग्). In the same way, binary molecules of the other Bhutas are formed. The atoms are possessed of an inherent Parispanda (rotary or vibratory motion), and when they unite in pairs, so long as there is no chemical operation under the action of heat corpuscles, the original qualities of the atoms produce homogeneous qualities in the binary molecules.

The question as to the existence of a triad, a tetrad, a pentad etc. of atoms is one of the most points of the Nyaya-Vaisesika. The orthodox view is that, the primordial infinitesimal particles (atoms) start with an incessant vibratory motion विद्युतपरिक्रमापारमितपद्मादिपरमाद्यः, Raghunâtha S'iro-mani—विद्युतीक्ष्णतात् पद्मपद्मद्वयः पद्मोति, Udayana, Kusumâñjali), and an inherent impulse that drives them to unite in pairs—a sort of 'monovalency', as it were, exhausted with the formation of a binary molecule. The binary molecules now combine by threes, fours, fives, etc. to form larger aggregates as well as the variety of elementary substances, the particular collocation in any case being not only determined by physical causes, but also serving to satisfy the ends of the moral Law in creation (वहा, कर्म), (धर्मसंविरागते इति विद्यते,

न वापि । पृष्ठ लिपिम् । चदाचित् विभिरारम्भते इति ।
 अपुक्षित्युच्चते, चदाचित्युच्चिरारम्भते चदाचित् पृष्ठमिदिव वदेत्
 वर्णना । चहटवान् तथा तथा तेषां वृहो वदा वदा वदारम्भेऽ
 एवरवाती वदन्ते । चहटकारिता वस्त्रावासानी उद्दिः । S'ridhara,
 Nyāya-Kandali, शृण्वनिष्ठव्यम् ।) Cf. Vācaspatī's
 report, Bhāmatī, Chap. II., Pada II. Sūtra 1L यदा
 चतुरशुक्लारम्भते चतुर्वांशः वृद्धावासारम्भवान् । Prasastapāda
 appears to have originated this view (परमाहडादृष्टे
 वृहवंका तिरात्मे वाचादिवद्वये—Prasastapāda, परिकाव
 निष्ठप्यम्) ; but that another view was also main-
 tained in the Vaïesika School is evident from the
 brief summary of Kasāda's system given in
 Utpala's commentary on the Vṛihatsaṁhitā, and
 this indeed also follows from S'ridhara's admissions
 in the Kandali. On this view, also, atoms have
 an inherent tendency to unite, but some unite in
 pairs, others in triads, others in tetrads, etc.
 This may happen in two ways,—either by the
 atoms falling into groups of three, four, etc.
 direct, or by the successive addition of one atom to
 each preceding aggregate.

A triad (Tryanuka), then, holds together three
 atoms (Anus), not three binary molecules (Dvyanu-
 kas) as on the orthodox hypothesis. Similarly with
 tetrads, pentads etc. पृष्ठिव्यम् परमाकृतः वित्तव्याचित्याकृतान् ।

सांकरो वरमात्मा इष्टवारभै विभिः परमाद्विकारकारभै च वि
श्वेष च चकाक् इष्टव्योत्पत्तिः । Utpala, Chap. 1, S'loka 7 ;
cf. also S'rīdhara's admission, चक्रा वहि परमात्मो धृष्ट-
वारभै वक्षुद्वितात्माचक्षमारभै चक्षुद्वितात्मु इष्टवारभै तकापि कुती
विषय एव इष्टव्य । S'aṅkara seems to speak of two binary
molecules in the Vaisesika as forming a tetrad,
(वहापि च धृष्टे चतुरचक्षमारभै—S'āṅkara-Bhāṣya, Chap.
II, Pada Sūtra, II, where the Bhāṣmti gives a forced
interpretation).

In Prasastapāda's view, these binary molecules
are grouped by threes, fours, fives etc. (त्रयः, चतुरचक्षः)
to form different isomeric modifications. The variety
of Earth-substances is due to differences in the
arrangements of the molecules (e.g. their greater or
less density, and, above all, their grouping or collo-
cation चक्र, चक्रवर्णविवेच), which account for the speci-
fic characters (वरमात्मि) manifested by these iso-
meric substances. ता इवी च स्त्रीवद्वर्णविवेचविविदा
वरमात्मिवृत्तीपेता । Prasastapāda, शक्तोनिष्ठपत्तम् । जोये
विविडन् । नाहिव्यात् विविदताविपरिदृष्टः । परमात्मद्विउ
वरमात्मविवेचिपि चहृष्टवात् वहा वहा तेषां चक्रः वहा वहा वहारभै चु
वरमात्मो चक्रमि । S'rīdhara, Kandali, ibid.

केवं लिता चिरकावाचकादिविभिति वायत् । वात्सित्वादित्ववाच
वाचादिच्छुद्विरीविवेच । चक्रवर्णविवेचः वत्यत्तदावादिविभित्ववाच-

संस्कारविदेशः । ए तु एवहृष्टवाचरि सत्त्वदिः । असाधीनो वत्तिष्ठित्-
स्त्रांश्चैव वद्य व्योपनिषादात्माविषेव वाहुरत्नात् । Udayasus, Kiranā-
vali, ibid. These original differences in molecular grouping leading to distinctions of genera and species,
however mechanically or physically explained, come
also under the operation of moral and metaphysical
causes (प्रकृति, प्रकार), i.e., of ideal ends in the moral
government of the universe, which are superimposed
upon the physical order, but which do not come
within the scope of Natural philosophy. An elemen-
tary substance thus produced by primary atomic com-
bination, may, however, suffer qualitative change
under the influence of heat (पात्रबोधपत्रि). The pro-
cess is as follows :—(1) the impact of heat corpuscles
decomposes the binary (tertiary; or quaternary) mole-
cules into homogeneous atoms possessing only the
generic characters of the Bhūta concerned ;—(2) the
impacts of heat particles continue, and transform the
characters of the atoms; determining them all in
the same way ;—(3) the heat particles continue to
impinge, and reunite the atoms so transformed to
form binary (or other) molecules, in different orders
or arrangements, which account for the specific
characters or qualities finally produced. The Vaise-
shika holds that there is decomposition into

homogeneous atoms, transformation of atomic qualities, and finally recombination, all under the influence of heat. The Nyāya on the other hand thinks that the molecules and larger aggregates assume the new characters under the influence of heat without decomposition into homogeneous atoms, or change of atomic characters (पितृपाद or पिठृपाद).

तैवाननुमानेन विभाषः परिकल्पते। सम्बादवदेत् च ग्रन्थिव-
शातपूर्वकपूर्वकपादिविवरणवृत्तीपवास्त्वेत्यःप्रवेशः इत्यामीरमुनीष्मि तेज
विद्यता चहित्येच त्रीदात् च विचारात् च चून् चठायारपूर्वक-
चवदवेत् विदा वायते विदाती विभाषः विभावात् उच्चारपूर्वकंसीव-
विभाषः। तदिकावात् इत्यविभाषः। पठाव व्याख्यादिव्याकामवद्यतः
रक्षादिव्याकामवद्यतननुभवतः—चहटपूर्वकात्ताः परमर्थं संयुज्य रात्रिकादि-
प्रक्रमेव ताहमेव चठादिकार्यंतारत्यन्ते। एव तपत्वातपहमानेत्
पादादिकर्त्तव्ये एव एव व्याकः वरीते विद्येच तैवान परकामेत्
चहटपादादित् रक्षादिकामवद्यता विभावनमुपवक्तृत् तदेव विचक्ष-
मुवपादविभावी चंसवत् इति। (Jayanta, Nyāyamāñjari
मूलपौत्रपूर्वक). This is the Vaisesika view, but
Jayanta himself inclines to the opposite view :—
वहटत्वदिवरत्येव कार्यद्वच्छ चठाति। आरपाद् चमलेवःक्षामुदविभाव-
पादीपवक्ते; चर्तु विभाववद्यता। विठरपादपव एव विषवः। ibid.
The Nyāya view :—ते त्रीज्ञावदवाले पूर्वचूपरिवादेव

व्युत्तानसापदमे व्युत्तानसापसी च विदीषामुरद्वातुना वंशहीत
वासदेव मैवया पञ्चाबो रुद्राद्वा विवेत्त्वति च रुद्रः पञ्चाद्वावहाहिती-
द्वा एविद्वावसापदमे। परमाक्षाणि वीक्षाणि भवनोवेत्तत्र विविधामर्ह।
वासदाव्याहितीव्युत्तानसापसीद्वा तत्र वासदुपासां वाहितीवसापे
तासद्वा वाहितिं परमाप्यवस्था भवति। विद्वा तात् वाहिति लोपवलेत।
Udyotakara, Chap. III, A'hnika I, Sutra 4.

11. Chemical combination (व्युत्तविद्या, संस्कृतिका).
Chemical combination takes place either between
two or more substances which are isomeric modifi-
cations of the same Bhūta, or between substances
which are modes of different Bhūtas.

A. Mono-Bhautic compounds. The simplest
compounds are Mono-Bhautic compounds,
i. e. compounds of different substances
which are isomeric modes of the same
Bhūta.

(a) Mono-Bhautic compounds of the first
order :—Under the impact or impulse
(अविद्या or शोदय) of heat corpuscles, the
substances in chemical contact (वासद
संविद) break up into their atoms. These
atoms are homogeneous, possessing only
the original physical and chemical charac-
ters of the Bhūta concerned. As the speci-

fic differences between isomeric substances arise from the arrangement or collocation of the atoms, the substances lose their distinctive marks on decomposition into the latter.

(न च परमाचु चपरमातिमेदा विद्यते न च
वयसीचार्याचितोबपरमाचुमा चविद्विमेषः ।

Uddyotakara, Chap. III, Añnika I,
Sūtra 4. न च वयसीचितपरमाचुमा चविद्-
विमेषः वाचितपरमातिमेषः । Sridhara, Nyāya-
Kandali, शृणुनिष्ठष्टु । Under the
continued impact, (or, it may be,
impulse) of heat particles (तेजसा वाच-
दम्बेष लोकात् चमिकातापि च—Jayanta),
these atoms take on new charac-
ters. It is heat and heat alone that
can cause this transformation of the
colours, tastes, smells, etc., in these
original Bhūta-atoms. What parti-
cular colours, tastes, smells or physi-
cal characters will be produced in the
atoms depends (1) on the nature
of the constituent substances in con-
tact, (2) the intensity or degree of
the heat (तार, चु or त्रिभुतं पात्र), and
(3) the species of Tejas-corpuscles

the impinge on the atoms, or the nature of the impact (विषयवस्तुः संकीर्ति) . (न हूमोऽप्तिमेवीतात् एषात् उपादव इति चापि त षुभंहपादिक्षियोत्तापेत्तात् । बद्धम् पद्मे चप्तिसंयोजित तत्र ते पञ्चहपादवत्तेषां च अवती विषयवस्तुपैचत्तापः चप्तिसंयोजित उत्तरात् उपादोन् विषिटात् अथैति । Vide also Uddyotakara III, 2, Sutra 16. Cf. also Váchaspati, I, 1, Sutra 4. चप्तिसंयोजित चप्ति उपादवत्त विठरस चौक्तापराक्तम् च चप्तिसंयोजित पञ्चहपादिक्षियोत्तापां उत्तरात् मेहात् निरुत्तातोत्ता जाहन वभुपरस्परां च विद्वातः) ।

Now when the atoms have all been determined in the same way, they begin to recombine again under the impact (or impulse) of the heat-particles in binary molecules, (or tertiary, etc.), and these in higher aggregates. It seems to be generally held that, at the final step one or more atoms of one constituent substance unite with one or more atoms of the other constituent substance or substances to form a molecule of the com-

pound ; but the question is not of much significance for Mono-Bhautic compounds of the first order, as, in these cases, the atoms have before this all lost their distinctive characters and become homogeneously transformed. The compound so produced will possess the new characters of the transformed atoms, so far as taste, colour, smell, etc. are concerned, but as the molecular arrangement or structure (व्यवस्था) may vary, different compound substances may result from the same components.

(b) Mono-Bhautic compounds of higher orders :—Again, Mono-Bhautic compounds of the first order may chemically combine to form higher compounds, and as the ultimate Bhūta substratum is the same, the process of decomposition and recomposition will be essentially the same as before. The only doubtful point is whether in this case the component compound substances are broken up only into their constituent molecules, or into the original homogeneous Bhūta atoms. Some of the later Vaisesika Scho-

lists hold that the latter happens in every case of chemical composition, however complex, but the earlier Vaisesika conceived that in the case of compounds of compounds, the decomposition does not proceed so far as the original Bhúta atoms ; but that it is the specifically determined atoms constituting the molecules of the component compounds that are transformed under the impact of the heat-corpuscles ; and then one such transformed atom (one or more according to another version) from the molecule of one component unites with one similarly transformed atom (one or more according to the other version) from the molecule of the other component. Praastapáda, the great Vaisesika Doctor, holds this view. When, for example, in the fertilised ovum, the germ and the sperm substances, which, in the Vaisesika view, are both isomeric modes of Earth (with accompaniments of other Bhútas), unite, both are broken up into homogeneous Earth-atoms, and it is these that chemically combine under the animal heat (and bio motor

Energy, जातु) to form the germ-plasm (जन्मसत्त्व). But, next, when the germ-plasm develops, deriving its nutrition from the chyle (blood) of the mother, the animal heat breaks up the molecules of the germ-plasm into its constituent atoms (जन्मसारथक्ष-परमाणुः), i.e., into atoms specifically determined, which by their grouping formed the germ-plasm, and then these germ-plasm atoms as radicals chemically combine with the atoms of the food constituents, and thus produce cells and tissues. (समुद्रपञ्चाकर्णेः जन्मसारथक्षपरमाणुभिः पहृष्टवात् उपत्रात्तिक्षेः जाहारपरमाणुभिः सह सच्चय वरोरात्मारम्भते इत्येवा जन्मना। पितुः यहं नातुः शीघ्रितं तत्वाः सत्रियातामलर्तं बठरानवस्थात् इत्यादीर्घितारम्भं पुरमा। यहु पूर्वदशादिविकारे सति जन्मसारथक्षरोन्पत्तो वाचाहिनीक्षमेव जन्मसारथरोन्पत्तिः।

...तत्वं नातुराहाररतः जाहारा लक्षात्वति पहृष्टवात् तत्वं पुनर्जंठरानवस्थात् जन्मसारथक्षरमाणुपूर्वदशादिविकारे नटे समुद्रपञ्चाकर्णेः जन्मसारथक्षरमाणुभिः पहृष्टवात् उपत्रात्तिक्षिः

शास्त्रारपरमाचयिः एव उपच वरोदान्नरभारभै
हस्ता वस्ता । Sridhara, Kandali,
त्रिलोकीनष्टपत्रम् ।) In this hypothesis
(वस्ता), it is assumed that the
atoms are similarly transformed, i.e.,
become endowed with the colour,
taste, smell, etc. of the product (the
cell or tissue), the moment before
the chemical combination takes place.
Similarly, when milk is transformed
into curd, one view is that the trans-
formation takes place (under internal
heat) in the constituent atoms of
the milk molecules, atoms specifically
determined as milk, and not in the
original atoms of the Bhūta (or Bhūtas)
entering into composition of milk.
(Cf. एवं महाद्वारारभैः परमाचयित्रैव दधा-
रभैः । एषाहितेष दधारपाकेरैव पर-
माचयित्रैवकीतारभैः इति दित् । Nyaya-
bodhini, on Annam Bhatta's Tarka-
saṅgraha.) Cf. Dinakari, on the other
hand—शास्त्राच्छपदुक्तव्यं दधव्यनेत्रिपि तत् (दृष्टिः ॥)
In these cases, the atomic contact
is called constituent contact

(वारपदवीय), and all the atoms are equally regarded as material causes (उत्तमकारण or कर्मकारण) of the compound.

B. Hetero-Bhautic 'quasi-compounds'.—The Nyāya-Vaisesika maintains that in the case of bi-Bhautic (or poly-Bhautic) compounds, which are only quasi-compounds, there is another kind of contact between the heterogeneous atoms of the different Bhutas, which may be called dynamic contact and is distinguished in its operations as Upashtambha, Vishtambha or Avashṭambha (उपष्टम्ब, विष्टम्ब or अवश्टम्ब). In some cases, it so happens that the atoms of different isomeric modes of the same Bhūta do not chemically combine under the mere application of heat ;—they require to be surrounded (and 'excited', 'energised') by atoms of different Bhūtas. For example, in the case of the oils and fats as well as of plant saps and fruit juices the Earth-atoms must be dissolved in water (Ap), and it is only when the water atoms (Ap-atoms) congregate round the former that dynamic intra-atomic

forces are set up, and the Earth-atoms (with the water atoms in dynamic contact) now take on peculiar infra-sensible characters (colours, tastes, smells) under the impact of the heat corpuscles, and then, under further impact, fall into groupings or collocations (of a very peculiar nature, to be presently explained) which determine the nature of the composite substance thus produced. Here it is the water-atoms that are dynamic (उपशम्भक), and excite the Earth-atoms, and these substances, oils and fats (तेजस् and उष्णत्वं), as well as acids (चम्पयं) are, because of the Earth radicles regarded as Earth-compounds (or Earth-substances). (पात्राच्च-तत्त्वाविधिवर्थादुपादिनः। परवाचनिद्रुक्तादिक्षेच इतादिद्वयामारथते। तत्त्वं च उपशम्भवत्वा निनिततामापद्धाः पात्रीवादवयाः। तेजस् संदुग्धसमादैन लेहकबोधवाचते, तेजस्त्रीरादिव पात्रिवर्थसिद्धिः। तेजस् भौमामहेश्वरवान् इत्यत्। Udayana). In the above instances, Ap (water) acts as dynamic (Upashambhaka, (उपशम्भक), but Tejas

and Vāyu can also act in the same way on Earth-particles. Conversely, Earth-particles may act dynamically on the atoms of the other Bhūtas. For example, in the case of mercury and the metals which are conceived in the Nyāya-Vaisesika to be igneous bodies (in fact they are supposed to be formed under the subterranean heat आवरण), the Tejas corpuscles are believed to form the radicles, and the Earth-particles are dynamic (उपदण्ड). (सुवर्णोदि निरन्तरं भावानामपि न पूर्वाहर्यं बहाति । तेजेष्व द्रव्यानामैकं पतिष्ठतात् उपदण्डकीर्तिपि पार्श्वध-भावः उद्धरणं पश्यनुवर्तते । एतम् चुट्टाकांडिना रक्षारता हक्कते तत्त्वशीघ्रतामिग्रावक्षततद्दृश्योप-वनात् । एतेन पारदादि व्याख्यातम् । Udayana, Kiranāvalī, तेजोनिष्ठपत्तम् । Cf. also कीर्तिपि तेजसनिष्ठति सुरसे तेजावद् पार्श्वधी भाव उपदण्ड एष्वः ।)

It may be here noted that Gaṅgesa, the author of the Tattvachintāmani, conjectures that even gold can be evaporated or made to disappear by the application of intense heat;

यत् त्रिभूततरादि: त्रिव्यः प्रतीतेः उपचारम्-
मंडीवेद त्रिवर्त्मानाम् तदहमवता नवाति । But
Mathurānātha notes here—मध्यग्राहकादो-
षेदहमवै । (उद्धिकर्त्तव्याद्वाच) .

But while every Bhūta can act dynamically as उपचारम् 'energiser', 'exciter', it is the Earth-Bhūta alone which is capable of exercising the power of arrest or inhibition of molecular motion or the motion of particles due to gravity as in fluids (Viśtambha, विष्टम्ब), or the power of counteracting the tendency in a given set of atoms to fall into a peculiar order or group (अङ्गिरोधितम्), (ए च पाञ्चिकरम् चक्री इवामरं वस्त्रादित्प्रभावितं पूर्णं वृक्षं च विद्युतिः । Udayana, Kiranāvalī, इङ्गिरोधितप्रभम् । विद्युत्प्रभं स्त्रामा-विकारम् वस्त्रामरवित्तिप्रभकलम् । अङ्गिरोधितं च स्त्रामाविकारम् वस्त्रामरवित्तिप्रभकलम् । Vardha-mana, Kiranāvalīprakāsa, ibid.)

Oils, fats, milk—Bi-bhautic quasi-compounds, with Ap as energiser :—Oleaginous substances

(चावलैचादः च च) are divided by Udayana into (1) oils, derived from vegetables, (2) butters derived from milk, and (3) fats derived from animals. The medical schools, as we have seen, recognise animal oils as distinguished from vegetable oils. Vegetable fats (e. g. बिल्लूत्) are also mentioned. Viśheśpati in the Tātparyyatākṣaṇī contends that mustard oil has not the flavour and smell characteristic of the true oils (sesamum, linseed etc.), and is classed with the latter by convention. Judged by the flavour test. A'mikshā (the casein substance formed by mixing milk-curd with hot boiled milk) is to be classed with milk substances. So also Takra, whey,— but Vajina, the thin fluid that is left after the Am'ikshā (casein substance) is separated, cannot be classed as milk. It may be added that the milks and curds as well as oils and fats derived from different species of vegetables or animals are supposed to differ in their ultimate structural arrangement and therefore in kind ; but Vallabha thinks that the ghees (clarified butters) prepared from different kinds of milk are of the same kind , in other words, the milks and curds are 'polymeric', the ghees (clarified butters), 'isomeric', using these terms, as before, in a loose general sense.... तेष्वप्रत्ययामि शब्दो-
नामकीमिताम् । चतएव नारिकेशंहस्तापि तेष्व रसाद-

कांचपादपि तु इत्यपदिक्षा । Udayana, Kirasavali,
पश्चिमीनिष्ठपदम् । Vallabha notes that ghees do
not differ in kind, as milks (and curds) do :—
ततो भास्त्रसंवादिद्वयेन्द्र दृष्टव्यत् इवादितु जातिमेह-
प्राप्तानिति रेतः ।—Vallabha, Līlavati. Compare
Vāchaspatti, II, 2, 65 :—पाचतेरादीना जातित्वं बन्धेत वा
रसेन वा अल्पते । अतएव न वाचपादोना तेजस्तत्त्वात् । तदाचारयो-
ग्मधरमवीरभावात् । भास्त्रं तेजस्तद्वीदः । शीरजातिरपि रथ्यक्षेत्रात् ।
प्रदप्तवानिष्ठावाः चोरत्वम् । ए तु प्रजिग्रह तदव्याप्तकम् रसमेहम्
प्राप्तिमे चमादात् चामिषादात् च भावान् ।

III. Mixtures like soups, solutions etc :—A soup is a physical mixture of a peculiar kind, from which evaporation ordinarily sets the water free (cf. Udayana's चन्द्रोदयग्रन् infra). When meat is boiled in water, there is the application of heat, with chemical changes in the meat, but the combination of meat-particles and water-particles in the soup is only physical combination, and not a chemical one. It is of course not a true compound, neither is it a quasi-compound, like milk (in which the water-particles are 'energisers' of the Earth-particles). Milk, for example, retains its milky substance, when it coagulates or becomes solid, (this of course is also the case with mono-Bhautic substances whether elementary or compound, e. g. water, which becomes ice,) but the substance we call a soup or solution ceases to be a soup

or solution, the moment it solidifies. Uddyotakara notices gruel, baths, and lyes (alkaline solutions) as mixtures of this class (सर्वेन पापकाचिकित्सेकावचारादः वस्त्राः । Vārttika, Chap. I, Ā'hnika I, Sūtra 14).

इसी हि भाव उत्पन्नपाकवाना द्रव्यादी काष्ठविशेषातुरहि इति
द्रव्याकरणदृष्टाना पापकोवस्त्री एः संकीर्णः ए द्रव्य इति । सर्वेन
पापकाचिकित्सेकावचारादः वस्त्राः । Uddyotakara, Vārttika,
Chap. I, Ā'hnika I, Sūtra 14. Vide also Vāchaspatti's comment : उत्पन्नपाकवाना संकीर्णे एव पिण्डान-
पिण्डावशाना द्रव्याकरण तीक्ष्णे लंबुग्रामा पापकोपचो रुक्षा ए
चाहो रुक्षा रुक्षलं काष्ठविशेषातुरहि वरोति । ए ए संकीर्णमेह-
एव तोषमासकीर्णतु चरवाती विजातीवकीरकारचक्षवान् । जापि द्रव्यातीर्थ
तीवरमेहि इत्यं तीरकातीवलिकेति तु कम् । तीवरिहि काठिकृपि
तीरतुहिष्पटेवकीरकावश्चात् । एष तु काठिक्ये ए द्रव्युहिष्पटेवकी
इति द्रव्यमेहि एव तोषमासकीर्ण इति वाप्यत् । ए ए चतुर्मात्रिकः
संकीर्णमेहिरितः । Vāchaspatti, Tātparyyatikā, ibid. For
salt and alkaline solutions, vide Kiranāvalī—सर्व
पुनर्व्युत्तिविभूषिते चाराहिरपि रुक्षः पापकी उपचयते ए
द्रव्यमूषकपाकवस्त्रे पापिवद्वकोपाचिकः । चतुर्मात्रा तत्त्वे चतुर्मात्रमुष्ट्वा
रुक्षी नभुर एव । Udayana, Kiranāvalī, वस्त्रविषयवद् ।

Chemical action and Heat.—The operation of heat is of course universally implied in chemical

combinations. Where the application of external heat is wanting, Vātsyāyana, the great Doctor of the Nyāya, points to the operation of internal heat. (e.g. वृषभोदामः चक्षुरुमा संस्कृतः चापरेऽत्रिभवा पचनाम् रुद्रम् निर्विनाशितः—Vātsyāyana-Bhāshya, Chap. IV, Āṇika I, Sūtra 47). In the case of combustion, we have seen Vijñāna-bhikshu explain the heat as latent in the Earth-substance, the fuel, from which it breaks forth. Udayana points out that the solar heat is the source of all the stores of heat required for chemical change in the world. The change of colours in grasses, for example, is due to Tejas, in the form of latent (invisible) heat, not in the form of Agni; and the cold in winter cannot take away this store derived from the Sun. (दधादिविकारो हि बहु उपादिपराङ्गतिमाप्तिः स मनोऽग्नयेव त्रिभवा वर्णवः। वाहूर्धि च पादे अन्तिमित्य इति। न विविदमिष्टमापयते। न हि दीरज्ञ त्रिभवः वेष्टीवपादहेतोऽिंशादपवदः चतुर्मिति। एव विकारो मण्डादिष्टपी विवरितः सोऽसिद्ध एव इमहेतु दधादिष्ट च विरीभौ वासी च। एव उपादिपराङ्गतिमाप्तेव चतुर्मिति। वाहूर्धि तदवश्यम्। तद दधादिपराङ्गतिमाप्तेव वीम्यानुपचक्षाचित्तलाभ् चताहूर्धवा त्रिभवादस्त्रिभौरुपवदाभ्याम् च। Udayana, Kīraṇāvalī उपादिपराङ्गतिमिष्टपवदः।) Similarly, it is under this solar heat that the unripe mango ripens, i.e. changes

colour, taste, smell etc., showing that there is chemical transformation or subtle decomposition and recombination going on; and this is also the case with the rusting of the metals, which is a combustion due to the solar heat (सूर्यपात्र) even as the conversion of food into chyle and of chyle into blood are instances of chemical action due to the internal animal heat (अठरात्र or शोषये रेतः). But the kind of contact with heat-corpuscles, in other words, the kind of chemical action (पात्र) which transforms colours is supposed to differ from that which transforms flavour (विषवस्त्रिक्षणंशील) and पात्र) and this last from that which produces a change of smell, or tactile quality. (पात्रो नाम विज्ञातीवतिक्षणंशीलः । एव च नामात्मातीवः । उपर्युक्तो विज्ञातीवतिक्षणंशीलोदयेत्वा रक्तग्रन्थो विज्ञातीवः । एवं अमांदो चापि तत्त्वा । एव इत्यादिव भिज्ञमित्वातीवाः पात्राः कार्यं वस्त्रेण वस्त्रानोदाः । तत्त्वाहि उच्चुपात्रिविज्ञातीवतिक्षणंशीलाद् पूर्व-इतिहरितप्राप्तप्राप्तारम् पौत्रादिवस्त्रिपात्रः पूर्वरक्तम् अस्त्रेणानुभवात् । अतित् पूर्वहरितहरितेऽपि रक्तपराहनिहर्मात् विज्ञातीवतिक्षणंशीलम् उपपात्रवत्तात् पूर्वतत्त्वानुरक्तवत्तात् अधुररक्तवानुभवात् । तत्त्वाद् पूर्वतत्त्वानुरक्तवत्तात् रक्तग्रन्थो विज्ञात् एव रक्तग्रन्थो विज्ञात् एवाहीकार्यः उपराहीरपराहनी चापि पूर्वदत्तत्वानु विज्ञातीवतिक्षण-वत्तात् तुर्मित्वीक्षणः । एव अर्द्धवक्षीडपि पात्रवत्तात् उठिष-

स्वर्णकारि यदुच्छ्रांतुमवात् । चतुर्थं पादिदपरमाकृनामिकमातीवत्तेऽपि
पादमहिता विकातोद्गत्वाकरामुभयः । वसा गोमुकदवादीना चापर-
माकलं अस्ते दक्षारचकपरमाकृतु विकातोद्गत्वाद्वीमवदाम पूर्व-
कपादिदपरमाक्षेत्रं तदवत्तरं इत्येवं वाह्यं कपादिकं वर्त्तते
ताहमहपरत्वमध्यंश्चनकादेवासंखोदा वादते । तदवत्तरं ताहमहपरत्व-
मध्यमध्यमेव । ताहमहपरत्वमध्यमध्यमेव तदवत्तरं ताहमहपरत्वमध्यमध्यमेव । तद-
वाचकादिदपरमेव नहादुन्धारण इति । Nyāyabodhini on
Annam Bhatta's 'Tarkasangraha'). Heat and light
rays are supposed to consist of indefinitely small
particles which dart forth or radiate in all directions
rectilinearly with a sort of conical dispersion and
with inconceivable velocity. They may either (1)
penetrate through inter-atomic (or inter-molecular)
spaces as in cases of conduction of heat which when
applied under the pot boils the water, or fries the
paddy where there is no chemical action in the pot,
no decomposition and recombination of its atoms, no
change in the molecular collocation ; or, as with light
rays in cases of translucency or transparency
(व्याप्ता) penetrate through the inter-atomic spaces
with Parispanda of the nature of deflection or
refraction (तिर्यक्षदवदाम, Udyotakara), in the same
way as when fluids penetrate through porous bodies
(तथा परिक्षेपः विश्ववदनं परिक्षेपः वात इति—Udyo-

takara, commenting on Vātsyāyana's परिचय-
शिरसी, Sūtra 47, Ahnika I, Chap. III.) or (2)
impinge on the atoms, and rebound back—which
explains reflection (मुख्यं चित्तशिरस—Varāhami-
hira, रथवराहसंह—Vātsyāyana) or otherwise be
obstructed by the atoms in their path, which would
explain degrees of opacity, the casting of sha-
dows, etc., all these operations being also physical,
and unattended with decomposition and recom-
position or alteration of molecular grouping, or
(3) lastly, strike the atoms in a peculiar way,
so as to break up their grouping, transform the
physico-chemical characters of the atoms, and again
recombine them, all by means of continual impact
with inconceivable velocity, an operation which
explains all cases of chemical combination.
(अचिक्षो हि तेषां वाचसादिवदेव वैदाविश्वः एत् वाचीना
प्रवच्छादलविभिन्न एव भवति मधुक्षमाविभिन्न भवतोदर्थं वाकोक-
ट्वमिमानो शीक्षिकानाम् । (Udyana, Kiranāvalī, रेत्रीनिष्ठदप्तम्—
taken from Vāchaspatti, Tātparyyatākṣā, प्रवच-
ष्टवच्छप्तम् ।) Cf. also (वाचुर्वं तेजः वैदवता चाविदेव
मेवता च प्रतिष्ठते । Vāchaspatti—अर्द्धेऽपि विष्णितमपि तेजः
प्रस्तरं वाकादोदर्त वाक्षीति । सद् चतु उतोः प्रवचताम् ।
वाचावतः प्रवरदपि च स्वपरिमाचानुविधाविभिन्न प्रवदमात्रते तिं
तु विषयमेदानुविधाविभिन्न । ibid. Cf. अटिवाच्यन्तरितीप्रवचनिरपि

प वाद्यावदा अटिकादीनो तेजोवतेरप्ति वस्त्रवदा वदोपमादा-
हिंसोपदाः। Udayana, नैश्चिकपत्रम्, in reply to the
objection—इदि हि प्राप्त यज्ञोवान् प्रतिष्ठासिना अटिकाद्येष
विद्यावदात् प्रसुर्यन्तरादित्यं नाददीत वस्त्राद्याप्तवारि ततो न
तैत्तिरिम्। (Udayana, *ibid.*) Definition of वस्त्रता—
इत्याकराह पृष्ठाद्युपलक्षणवातः वस्त्रता। इत्यावतिवातः वाचाद्य-
पट्टाद्युपलक्षणारतोपदाः। वाचाद्यिति च पाचवाच
तैत्तिरिमिवातात्। Uddyotakara, Chap. III, A'haika
I, Sutra 38. वादिवरयः अटिकाद्यतिरेति पि होड्डिव-
चावान्। Sutra 47, where Uddyotakara notes—होड्डिव-
नविकातः—वस्त्र इत्यावदा च वृक्षाने तस्मा वस्त्राद्यवदः
वस्त्रावदानका होड्डिवरयः सोडिविकात इति। Váchaspati
explains वस्त्र इत्यावद् वर्णवक्षपात्रादिः वस्त्रवा च वृक्षाने
पूर्वाद्यप्रद्वारारक्षवक्षं होड्डिवादानं वृक्षावरक्षवक्षं होड्डिवादानं वृक्षानं
दद्य विद्यने तस्मा इत्यावद् वर्णवक्षपात्रादिर्ग्राह्यानान्न
वस्त्रप्रद्वारेऽपि विद्यन्ती एतुः होड्डिविकातः। Cf. Váteyá-
yana on Sutra 47, A'haika I, Chap. III. On the
other hand in chemical combination, वस्त्रः शैवः
ज्ञानोरनुभूतिः। तेज वैवदा वडित्येष भीहनान् चक्षि-
वादान् च च वर्षेत् विद्या, विद्यातो विद्याः, विद्यावात्
चारक्षवक्षं होड्डिविकातः *et c.*—Jayanta, Mañjari, शूलशैवव-
पूर्वपत्र। For opacity, shadows, &c., *vide* ज्ञाना तु
तेजः परमावदीरणवदात् मूर्तिवता परवानुग्रा तेजः परमाकु-
रावितते। यद्य च च चावर्णं तस्मा व्यावेति। विरक्ष-
देष्वः उपलक्ष्यतीति इत्युक्तव्याद्य व्यावा अविदीक्षते। उपलक्ष्यते

वाचस्पतिः सम्बोधि तु तद्वाचकान् । Uddyotakara,
Chap. IV, A'hnika 2, Sutra 25. For reflection, and
its laws, I quote passages in my paper on Hindu
Physics and Mechanics, to which the student of the
history of Optics is referred.

Arrangement of atoms in Space:—The Nyāya conceives atomic magnitudes as Pārimāndalas, a term which indicates a spherical shape. (नियं परिमांडलम्—परिमांडलमेव पारिमांडलम्—Saṅkaramis). To conceive position in space, Vāchaspati takes three axes, one proceeding from the point of sunrise in the horizon to that of sunset on any particular day¹, (roughly speaking, from the East to the West);—a second bisecting this line at right angles on the horizontal plane, (roughly speaking, from the North to the South), and the third proceeding from the point of their section up to the meridian position of the sun on that day, (roughly speaking, up and down). The position of any point in Space, relatively to another point, may now be given by measuring distances along these three directions, i.e. by arranging in a numerical series the intervening points of contact, the less magnitude or distance being that which comes earlier in this series, and the greater that which comes later. The position of any single atom in Space with reference to another may be indicated in this

way with reference to the three axes. But this gives only a geometrical analysis of the conception of three-dimensioned Space, though it must be admitted in all fairness that by dint of clear thinking it anticipates in a rudimentary manner not only the foundations of solid (co-ordinate) geometry, but also of the geometry of position, and especially the conception of Space as a Manifold, which alone can serve as the basis of a generalization comprehending all different possible kinds of geometry, Euclidean and non-Euclidean. (एवत्तेऽपि दिवः चादिक्षोद्दर्शकालस्तद्युक्तो वः स इतरकालस्तद्युक्तो द्विवदीयात् परमाणुः पूर्वः एवत्तादिक्षालस्तद्युक्तो वः च इतरकालस्तद्युक्तो द्विवदीयात् परमाणुः परमाणुः परिमः ती च पूर्वपदिमी परमाणुचयेत्त वः द्विक्षोद्दर्शकालस्तद्युक्तो वः स मध्य-वर्त्तोः। एवमेतद्योर्बी तिथ्यद्विवदीयालस्तद्युक्तो वः अध्यात्म चार्यदेव व्यवक्षितो पार्वतीनामी ती हस्तिनीतरो परमाणुः। एवं ज्ञानादिवर्णत्वं सर्वात्मकविवरणार्थं चयेत्त उपर्युक्तभावो इत्यतः। उद्ग्राहकालीनात्मन्मूलमे च उत्प्रियक्षियकर्त्ता पूर्व-संस्काराद्यज्ञानं च चतुर्थं परसंक्षाराद्यज्ञानं च सूक्ष्मम्। Vācaspati, Tātparyyatikā, Chap. IV. A'hoīka 2, Sūtra 25.

The original physical arrangement of atoms is also given. Each atom is in contact with six other atoms, which gives a cubical arrangement. एवं

दिक्षीयि एवता चवि संकोचा यत् जाताः सौरुषं परमाणुः।
 वट्टेन् तुवपद्धतीन् मूर्खाद्यमुक्तः न तात्पर्यमुक्तः। *ibid.*
 Cf. also the objection in the Buddhist Kārikā.
 वट्टेन् तुवपद्धतीन् परमाणुः वृक्षात्। एवा समानसंज्ञाने
 पितः जात्पर्यमावकः॥ This is the typical primordial
 arrangement, and variations in the collocation
 of atoms and molecules (अथ, वद्यत्वस्त्रिविद्). as
 we have seen, were conceived to account for
 the variety of isomeric modes of the same Bhūta,
 as well as of mono-Bhautic and poly-Bhautic
 compounds.

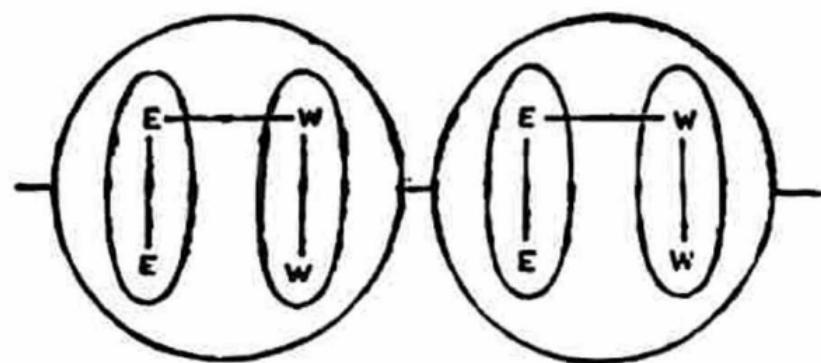
The molecular arrangement in the case of bi-Bhautic compounds is very peculiar. Two substances, say Earth and Ap (water), form a quasi-compound, first, and each substance breaks up into atoms, one atom of Earth comes into contact with one of Ap. But the two do not form a binary molecule. Instead, this contact of heterogeneous atoms leads to a curious result. The atom of Earth combines with a neighbouring atom of its own class, and forms a binary molecule. Simultaneously the atom of Ap combines with another Ap-atom, and forms a binary molecule. Now the first binary molecule links on to the atom of Ap, and similarly the second binary molecule links on to the atom of Earth. The moment after, the two binary molecules take on the physico-

chemical characters of Earth and Ap respectively, and simultaneously with the assumption of these physico-chemical characters, the binary molecules enter into complex contact (संकीर्ण संयोग). In all this process, work is done only in the first instant, in the contact of an atom of Earth with one of Ap—the resulting contacts, of atom with binary molecule and of the binary molecules with each other, involve no further expenditure of Energy. Thus we get a particle holding two binary molecules (of Earth and Ap respectively) in complex contact, and such particles continue to be formed. In this way the particles of the two substances arrange themselves, and the peculiarity of this molecular arrangement explains the resulting mixed or compound qualities of this class of quasi-compounds.

(संकीर्ण संयोगः) उत्पत्तिमात्रा
चिरोपदम् एव निष्ठिम् वारदसंविदारणः वारदा-
वारदसंविदपूर्वकः वारदार्थार्थः संयोगः ।.....एव-
आव इतिहासः चरमः । यदा वार्तिकावशीरणीः संयोगे
हति चरेव पार्श्वित्वं पार्श्वित्वं चरेव वार्तेव ए
चारदम् तुलपद्मं द्वीपो मनसङ्गात् वार्ता संयोगाभ्यां पार्श्व-
दावे इत्युक्ते तुलपदारभेदः । वतो विज्ञ् वार्ते इत्युक्ताः
वारदसंविदपूर्वकमेव वारदार्थार्थः तजिदेव वार्ते इतरेतर-
वारदार्थार्थताम् संयोगात् इतरेतरवार्तार्थवतो संयोगी तुलप-
दुत्पदेति । एव वारदम् । वारदसंविदावा एव चरेव वार्ते
चरदम् इत्युक्तं इति वार्ताः । वार्तः पार्श्वित्वं इत्युक्तं वारदसंविदावा

आवेद चक्रा सम्भवते । आवलपि दातरं दारक्षं वीरिया पार्दिक्षेति
 (Prastapáda-Bháshya, मुख्यतये उद्धोवनिहसनम् ।)

The whole process may be graphically represented as follows :—



E = an atom of Earth.

W = an atom of water (Ap).

E

E — a binary molecule
of Earth.

W

W — a binary molecule
of water (Ap).

Molecules of a bi-Bhautic quasi-compound ;—graphic formula of complex contact.

I will conclude this account of ancient (and mediæval) Hindu chemistry with a note on the conception of molecular (atomic) motion, Paripanda, and the different varieties of such motion which were conceived to account for the physical phenomena of sound, light and heat. Any attempt to differentiate rigidly between Mechanics and

Physics on the one hand and Chemistry on the other at this primitive stage would be an idle affectation. My paper on Hindu Mechanics and Physics will give a detailed exposition in a separate treatise.

Parispanda :—Resolution of all physical action into motion :—

Parispanda sometimes stands for motion molar as well as molecular, but more often for the subtle motion of atoms or molecules. The radical meaning of the term is whirling or rotary motion, a circling motion, but it may also include simple harmonic motion (e. g. vibration). All motion, operation, work (*क्रिया व्यापार*) is ultimately traced to this form of subtle motion lodged in the atoms or in the matter-stuff. The Vedānta, for example, speaks of a cosmic vibratory motion (*संक्षीप्त-विश्ववृद्धम्—Sankara*).—Akāsa, in the Vedānta, as we have seen, is the first stadium in the evolution of Matter, which gives off Vāyu, which gives off Tejas, and so on ; but Akāsa (Ether) itself passes through two stages before the emanation of the Sūkshmabhūta Vāyu :—(1) the motionless ubiquitous primordial matter-stuff (answering to the Sāṅkhya Bhūtādi) called Parinam kham (*गति खम्*) and (2) a subtle integration, the pure unquintuplicated Sūkshmabhūta called Vayoram Kham

(वायुर् अ) (answering to the Sāṅkhya Tanmātra stage). It is this subtle Akāra, in its Tanmātric integration, i. e. in the derivative form, which is subject to an incessant Parispanda. The gaseous stage of matter (the Vedāntic Vāyu) is indeed matter in a state of Parispandic motion (वायुः परिष्पन्दात्मकमात्र—Sankara). So also the bio-motor and sensori-motor principles apart from the directive Intelligence of the Self (जाग्रत् परिष्पन्दात्मकमात्रादैव—वाचस्पति चूर्जं पूज्यते तत्त्वात् नवःपरिष्पन्दात्म—Sankara). The Sāṅkhya also conceives this Parispanda to characterise every process and phenomenon of cosmic evolution (वायुं सक्तिं परिष्पन्दात्—Vāchaspati, Kaumudi). Bhutas, organisms, mental organs, as modes of Prakṛiti (considered apart from the Intelligence of Purusha) are all subject to this Parispanda वृद्धानां देह वृद्धनो देहानां उपादहते इति तेषां परिष्पन्दः । श्रीरामादोनो च परिष्पन्दः प्रकृत्या एष ;—Vāchaspati on Kārikā 10). On the other hand, Prakṛiti as the Avyakta, the a-cosmic, the un-manifest ground, with resolution only of like to like (वृद्धपरिष्पन्द), is devoid of all Parispandic motion (वृद्धपि वृद्धात्मात्पि परिष्पन्दवृद्धता विद्या, वृद्धपि परिष्पन्दो वाच्म । ibid. on Kārikā 10). The Nyāya-Vaiseshika finds Parispanda in all

forms of matter, except Akâsa which, in that system, is non-atomic and incapable of any change or activity (निष्ठा). But all atoms from those of Vâyu downwards, are in incessant motion. The world at bottom is an infinitude of continually whirling (or vibratory) particles (अवरतपरिवर्तनादापरिवर्तनादः—Raghunâtha ;—compare also Udayana-Kusumâñjali, Stavaka V.—परमादः फृष्टिलोकवाम प्रसाधारदेहः पत्तलीति ।). All physical action consists in motion. The Nyâya-Vai-seshika rejects force, power, operation (क्रिया) except as modes of motion. Jayanta indeed states : we do not acknowledge any mysterious power or operation, which the senses do not and cannot report to us. But this denial of Force (क्रिया) and of unperceived and unperceivable operation (क्रियाद्वयवादः) is put forward as a philosophical (epistemological and metaphysical) proposition to justify the Nyâya analysis of the causal *nexus* into mere invariable and unconditional antecedence among phenomena without productive power or efficiency अवशास्त्रित्युपच शिष्टाद्युक्तवर्त्तमा—Bhâshâ-Parichchhedâ. It is not of course intended to question the existence of Parispanda, which is of the nature of motion, and which, though subtle and therefore infra-sensible (इक्षु एवं प्रकृतय, not क्रिया), is the ultimate form of all physical

activity. (परिक्रम्य एव वीतिको आपारं करीत्वम् । चली-
न्द्रियस्तु आपारः पाकोदि यमः ।.....तत्त्वात् कारण-
क्षेत्रं वस्तु अवते यस्म । न पुनर्दद्यनाम्यती आपार-
उपचयने । Jayanta, Nyaya-Mahjarsi, Ahnika I).
The effect (no less than the action) is, in all cases of
material causation, the resultant of the combined
motions of the various (material and efficient)
causes involved (e. g. in the case of पाक-समुदित-
शैद्धार्थादुक्तवारकनिकरपरिक्रम्यः पाक
एव चतुर्भूते । ... एव आपार एवेदः सर्वः संकूप आपारः ।
तिं वस्तुतापरादः तदेव संकूप आपारात् ।—Jayanta, Nyaya-
mañjarsi, Añnika I).

But, in the Nyaya-Vaisesika, though all action
of matter on matter is thus resolved into motion,
conscious activity is sharply distinguished from all
forms of motion, as against the Sankhya-Vedanta,
which, as we have seen, considered every thing
other than Intelligence, the Purusha or the trans-
cendental Self, to arise in the course of cosmic
Evolution, and therefore to be subject to Parispand-
dic motion. (निषादिविषय इषाऽ आपारी ज्ञातुराम्यः ।
जटामालयहृष्टसिद्धान्तवर्णविक्रमः ।—Quoted in Jayanta's
Nyaya-mañjarsi, Añnika IV).

Santina, i. e. Gati-santina (including wave
motion and current motion or convection) : Kampa
santina, Spandana, (vibration) :—Charaka notes

three kinds of *māṇasas*, serial motions, viz., those of water, sound and light (वृद्धसामान्, वृद्धसामान् and वृद्धिसामान्). Chakrapāni points out that a wave of sound travels more rapidly than a wave of water, and much less rapidly than a ray of light. In Hindu Mechanics, a current of water (downward flow, अवाहन) is conceived to consist of particles moving in an uninterrupted series under the action of gravity and fluidity (गुरुत्वं and इक्षुत्वं). A ray of light implies the rectilinear propagation of indefinitely minute corpuscles, in all directions, with inconceivable velocity, and a sort of conical dispersion (परिक्षीर्णि देवतिवादः त्रिक्षेपसर्थं आप्तेति वृद्धसामान् Uddyotakara—Vāchaspati). A wave of water (वृद्धिसामान्) implies the transmission of vibratory motion in the water particles. (Cf. Jayanta—प्रकाशनपदोपादिष्ट—वदोऽवृद्धसामान्, A'bhūka II). A wave of sound is conceived by some on the analogy of a wave of water (वृद्धिसामान्), only the air-waves (cf. the Mīmāṃsā) or the sound-waves in and through the vehicle of air waves (cf. the Nyāya-Vaiseshika) travel by concentric circles not in one but in all planes. (N. B. this assumes transverse waves). Others hold that the air waves (cf. the Vākyapadiya) or the sound and air waves (cf. Uddyotakara) are propagated by the transmission of the vibration in all directions, leading to conjunction and disjunction of air-particles, so that the wave may be said to expand by alternate concentric

spherical layers of rarefaction and condensation (प्रस्तुत) (N. B. this assumes longitudinal waves),—
 (वादवीचाचार्य—cf. संकीर्णभाषा॒ वे॑ रम॒ टें॑ लिखाचा॒
 ग्रहमभिक्षुको नादमद्वाचाः (Savara-Bhāshya 1—1—17)
 अभिक्षाते॒ फि॑ वे॒ रिता॑ वाचः॑ लिभितानि॑ कामुकर्याति॑ एति॑
 चाचमाचाः॑ सर्वतोदिकात्॑ उद्दीपिभाचाम्॑ उत्पादयति॑—*ibid.*
 1—1—18). The Vākyā-padiya describes articulate sounds (Varnas) and indeed all sounds (sābdas) as
 only forms of air set in motion, with rarefaction and
 condensation (प्रस्तुत), and capable of variations
 of velocity and configuration (कामेष्वभिहृती शब्दः ग्रह्यं
 वृत्तिपद्धतैः॑ तस्मै वारदसामचान्॑ शेषप्रश्नशर्विष्यः॑ एनिपातात्॑
 विभजने॑ वारदत्तोऽपि॑ मूर्खः—Vākyā-padiya, Kānda
 I. Sloka 109) (*vide* my paper on Hindu Mechanics
 and Physics). (For the Hindu doctrine of scientific
 Method, *vide* Appendix; for certain interesting
 recipes of chemical technology, *vide* Addenda).

I had intended to conclude this survey of Hindu Physico-chemical science with a comparative estimate of the evolution of scientific ideas in the culture-history (kultur-geschichte) of the Chinese, the Greeks and the Arabs, as an Essay in the historico-comparative method of investigation (*vide* the Introduction to my Comparative studies in Vaishnavism and Christianity for a correction of this method), but space forbids, and the reader too, I fancy.

The Date of Basaratnasamuchohaya.

While the present volume was about to issue from the press, Mr. T. G. Kala, Editor of the Marhattā Journal "Samālochaka", sent us a critical notice of R. R. S. As there are some important historical facts brought to light and as the date of this work arrived at from quite independent sources tallies with that assigned by us (Vol. I. Intro. LXXXIX), we make no apology for reproducing its substance in a condensed form.

Charpati or Charpaśinātha of the Nātha school is mentioned in the R. R. S., (see VI, 58, Poona edition), as also king Singhana.

The Navanātha Saktisūtra, a Marhattā work by Narabari Māla, gives some legendary information about this Charpaśinātha and speaks of him as a contemporary of Matsyendranātha. On the left has

मन्त्रसेनाथ
शोरकनाथ
देवनीत्यनाथ
प्रिणित्यनाथ
आनंदिष्ट

been given the genealogy of the pupils of मन्त्रसेनाथ. The last, आनंदिष्ट or आनंदीर, was the celebrated Marhattā Saint and author of a commentary on the प्रवद्धोत्ता called शानेश्वरी.* It was written in Saka 1212, i.e., A. D. 1290. So मन्त्रसेनाथ and Charpaśinātha must have lived at the beginning of the thirteenth century A. D.

*See the concluding portion of शानेश्वरी, a Marhattā work.

The R. R. S. which mentions the Siddha Char-pati must be therefore later than the first half of the thirteenth century A. D.

दिव्यवाच II (A.D. 1069)

सिंहा I

सिंहा

सिंहा (A. D. 1191)

सिंहा (A. D. 1191-210)

सिंहा II (A.D. 1210-1247),

Among the Yadava kings of Devagiri or Daulatabad, there were two kings by the name of Singhana. Taking the Singhana mentioned by R. R. S. to be the second, we are required to place the composition of the

work in the latter half of the 13th century. On the whole the R. R. S. may be safely taken to be a work written about 1300 A. D.

THE WEIGHT OF AIR.

(By Principal B. N. Seal).

Experiments were of course conducted for purposes of chemical operations in relation to the arts and manufactures, e.g., metallurgy, dyeing, pharmacy, perfumery, cosmetics, horticulture, and themaking of glass (lenses and mirrors of various kinds are mentioned, the spherical, oval—गोल and वृत्त, being well-known—Pliny indeed mentions that the best glass ever made was Indian glass). But of Experiment as an independent method of proof or discovery, the instances are rare. I may

note one interesting example in Udayana's Kiranāvali, relating to the weight of air. Udayana argues that air must be a distinct and independent Bhūta, for if air were made of the Earth-Bhūta, it would have weight, and it has none. To prove the absence of weight, he refers to an experiment. A small bladder made of a thin membrane, filled with air, will not cause a greater descent in the scale than the same bladder weighed empty. Hence the air possesses no weight. Then Udayana makes an interesting statement. It may be objected, he says by one who accepts the weight of air—that this argument is inconclusive. For a counter-experiment may be suggested. The balloon filled with smoke (or gas, वायु) rises in the air, whereas the air-filled balloon comes down. This would go to show that air has weight. Udayana replies that this would only show that both smoke (gas, वायु) and air have no weight. The Hindus appear to have been ignorant of the principle of Archimedes, at least as applied to gases. Vallabhāchārya in the Līlāvatī speaks of a peculiar resistance to sinking (or gravity) exercised by water, which explains the tendency in certain objects to float or to come up to the surface of the water but the description shows that he had no clear ideas on the subject. Cf. Udayana, Kiranāvali, वायुविद्या॑; Cf. also Vallabhāchārya, Līlāvatī.

APPENDIX.

On the Scientific Method of the Hindus.

(By PRINCIPAL BRAJENDRANATH SEAL.)

The Doctrine of Scientific Method :—A study of the Hindu Methodology of Science is absolutely essential to a right understanding of Hindu positive Science, its strength and its weakness, its range and its limitations. Apart from this rigorous Scientific Method, Hindu Chemistry, such as it is, would be all practical recipe, or all unverified speculation. This, however, would be a very inadequate and indeed erroneous view of this early achievement of the human mind. That the whole movement was genuinely and positively scientific, though arrested at an early stage, will appear from the following brief synopsis of the Hindu Methodology of Science.

Criterion or Test of Truth (after the Buddhists) :—The ultimate Criterion of Truth is found not in mere cognitive presentation, but in the correspondence between the cognitive and the practical activity of the self, which together are supposed to form the circuit of consciousness. That knowledge is valid which prompts an activity ending in fruition. Cf. the distinction between सत्त्वादिकाम and विषमादिकाम। Also compare, मायतीकैवल्यकी प्रतिकामयांत् चैवत् प्रवाचन—

Vaisesika). Truth, the Buddhists contend, is not self-evidence, nor the agreement between ideas, nor the agreement of the idea with the reality beyond if any, for this cannot be attained direct, but the harmony of experience (समादृ), which is implied when the volitional reaction, that is prompted by a cognition and that completes the circuit of consciousness, meets with fruition, i. e., realises its immediate end (cf. Srisharsha, Khandana Khanda Khadya on the relation of ज्ञा to ज्ञातव्यद्वार). This is the material aspect of Truth. The formal aspect is given in a principle which governs all presentations in consciousness, and which combines the three moments of Identity, non-Contradiction and Excluded Middle in every individual cognitive operation [तदुपरिक्षणस्ति (identity); व्यतीकरणस्ति (non-contradiction) वृत्तीय-प्रकारादापि च तुष्टिति (excluded middle) इति एकमात्र-ज्ञापाद—Jayanta, Nyaya-Manjari, न्यायादेविभूषणम्]

Perception :—The conditions of perception, and its range and limits, were carefully studied. The minima sensible (e.g., the minimum visible, the Trasarenu, the just perceptible mote in the slanting sunbeam), the infra-sensible (व्यतीकरण द्वारा sometimes termed वृत्तीकृत the obscured (व्युत्थृत, e.g.—a meteor in the mid-day blaze), and the potential (व्युत्थृतिः), are distinguished; but finer instruments of measurement were wanting, and this was a principal cause of arrested progress. It may be noted that the measurement of the relative pitch of

musical tones was remarkably accurate and original (*vide my Paper on Hindu Mechanics and Physics*).

Observation (वैद्यनात्—Vaidaspati and Udayana) :—The entire apparatus of scientific method proceeded on the basis of observed instances carefully analysed and sifted. This was the source of the physico-chemical theories and classifications, but in Anatomy, the Hindus went one step further; they practised dissection on dead bodies for purposes of demonstration. Ingenious directions are given, e.g., the body must be first disembowelled and wrapped round with the kusa and other grasses, then kept immersed in still water for seven days, after which the medical student should proceed to remove the layers of the skin with a carefully prepared brush made of the fresh elastic fibres of green bamboos;—which will enable the tissues, vessels and ducts to be observed. Post-mortem operations as well as major operations in obstetric surgery (the extraction of the fetus, etc.) were availed of for embryological observations (e.g., it is stated as a result of observation that the rudiments of the head and the limbs begin to appear in the fetus in the third month, and are developed in the fourth; the bones, ligaments, nails, hair, etc. becoming distinct in the sixth);—and also embryological theories, e.g., the indication of sexual character in the second month by the shape of the fetus, the shape of a round joint indicating the male sex, and an

elongated shape as of a muscle the female sex (cf. Charaka, Sūtrasthāna, Chap. IV,— सरीदि माति चनः सम्बद्धते पिण्डं पेन्द्रियं च। तद चक्रं पिण्डः पुष्टः जीवं पेन्द्रियं च वृद्धं च पृष्ठाकारः। Chakrapáni notes: चनः चठिनः। पिण्डो चन्द्राकारः। सरीदि दोषसामुद्रेकाकारः। वृद्धं च वृद्धीश्चतम् loc. cit.) In Phonetics (as in the Pratisúkhyas, circa 600 B. C.), in Descriptive and Analytical Grammar (as in Pánini), and in some important respects in Comparative Grammar (as in Chanda's and Hemachandra's Grammars of the Prákrita Dialects), the observation was precise, minute and thoroughly scientific. This was also the case in Materia Medica, and in Therapeutics, especially the symptomatology of diseases. In Meteorology, the Hindus used the rain-gauge in their weather forecasts for the year, made careful observations of the different kinds of clouds and other atmospheric phenomena (e. g., they give the heights of the clouds, the distance from which lightning is ordinarily visible, or the thunder is heard, the area of disturbance of different earth-quakes, the height to which the terrestrial atmosphere extends, etc., vide Varáhamihira, Srípati, and the authorities quoted by Utpala). In Astronomy, the observation was, generally speaking, very defective as in the determination of the solar and the planetary elements, and this was probably due to the lack of practical interest, but the determination of the lunar constants entering into the calculation of lunar periods and eclipses, matters in

which the Hindus had a practical ceremonial interest, reached a remarkable degree of approximation (much above Graeco-Arab computations) to the figures in Laplace's Tables, which can only be explained by the circumstance that in the case of these constants the Hindus carried out for more than a thousand years a systematic process of verification and correction by comparison of the computed with the observed results (like the navigator's correction of the course of the ship at sea), a process which was termed इन्वरिटिक. In Zoology, the enumeration of the species of Vermes, Insecta, Reptilia, Batrachia, Aves, etc., makes a fair beginning, but the classification proceeds on external characters and habits of life, and not on an anatomical basis. In Botany, the observation was mainly in the interests of Materia Medica, and the classification was as superficial as possible. (Vide my paper on the Hindu Classification of Plants and Animals).

Experiments :—Experiments were of course conducted for purposes of chemical operations in relation to the arts and manufactures, e. g., Metallurgy, Pharmacy, Dyeing, Perfumery and Cosmetics, Horticulture, the making and polishing of glass (lenses and mirrors of various kinds are mentioned, the spherical and oval शूङ्ग and राज्ञ, being well-known—Pliny indeed mentions that the best glass ever made was Indian glass). And the

results of such experiments were freely drawn upon for building up scientific hypotheses and generalisations. But of experiment as an independent method of proof or discovery, the instances recorded in books are rare. I may note one interesting example in Udayana's Kiranāvali, relating to the weight of air. Udayana argues that air must be a distinct and independent Bhuta, for if air were a form of the Earth-Bhuta, it would have weight, and it has none. To prove the absence of weight, he refers to an experiment. A small bladder made of a thin membrane, filled with air, will not cause a greater descent in the scale than the same bladder weighed empty. Hence the air possesses no weight. Then Udayana makes an interesting statement. It may be objected, he says, by one who accepts the weight of air—that this argument is inconclusive. For a counter-experiment may be suggested. The balloon filled with smoke (or gas, वायु), rises in the air, whereas the air-filled balloon comes down. This would go to show that air has weight. Udayana replies that this would only show that both smoke (or gas, वायु) and air have no weight. The Hindus appear to have been ignorant of the principle of Archimedes. Vallabhachārya in the Līlāvati, it is true, speaks of a peculiar resistance to sinking (or gravity) exercised by water, which explains the tendency in certain objects to float

or to come up to the surface of the water, but the description shows that he had no clear ideas on the subject.

Mathurānātha, again, states that the determination of the degree of purity (the carat) of gold by rubbing against the assaying stone and observing the character of the yellowish streak against the black smooth background, is only an indirect means of ascertaining weight (मुख्यविवरण lit. specific gravity) —which seems to suggest that there was a more direct means of arriving at the latter. Probably this refers to the common Indian method of comparing the lengths and weights of wires of uniform thickness that can be formed by drawing different pieces of gold through the same diamond bore. I think it may be regarded as fairly certain that the Hindus were ignorant of Archimedes's discovery, an ignorance which, at any rate, they could not have well borrowed from the Greeks, no more than they could have thus borrowed their knowledge of things unknown to the Greeks themselves. [Cf. Udayana, Kiranāvali :—

वातुचिकिपदम्, किं च (वातीः) पृष्ठीते गुह्यतमपि लाग । न च
पदमापूरितम् चर्ष्णुटकादिः चपूरवदभातः चर्षिकं चयनमनम् । उत्तीष-
मानम् चूलापूरितेन इदम् चनेकालिकं इति चेत् । न । चर्षं चूलदग्धावाः ।
तात्परि चर्मसिद्धिर्होरवतिविद्विद्वा चर्मतीतेः ।—cf. Vallabhb-
chāryya, Līlāvatī—मुख्यविवरणेऽपि पादावाकामुख्यतित्रु भजनो-
नियमवद् चहटहित्रुकामा सामेऽपि पतनोन्पतनम्-नियमो भविष्यतीति ।

पैग वा। असाधीवमन् जलिन चार्त्ये पतनप्रतिवेष्ट उच्चाच्छन् एव च
प्रसाद शोभन् वस्त्रचिट्ठैव पतनप्रतिवेष्टामर्हात्। हृष्टुकमेव नव्यमन्त्र
उच्चाच्छन्]—cf. Mathurānātha. सत्त्वचिन्तामानि—पतन (विद्योपतन) वा तुर्कं
पीतामिक्षुवत्त्वत् फिल् पीतराता गुदत्वेवत्प्रसादवत्त्वमेव ततः।

Fallacies of Observation—Mal-observation and Non-observation:—These were carefully studied in relation to errors of observation, and Hallucination (पतन व्याध, चारीप) — which were ascribed to three causes :—(a) Dosha, दोष, defect of sense organ, as of the eye in jaundice, or of the skin in certain forms of leprosy (leading to tactile insensibility, cf. Susruta) or defect of necessary stimulus, e.g., too faint light, or undue distance or nearness, in vision ; (b) Samprayoga, सम्प्रयोग, presentation of a part or an aspect instead of the whole ; and (c) Sanskāra, संकार, the disturbing influence of mental predisposition, e.g., expectation, memory, habit, prejudice, etc.

The Doctrine of Inference:—Anumāna (Inference) is the process of ascertaining, not by perception or direct observation, but through the instrumentality or medium of a mark, that a thing possesses a certain character. Inference is therefore based on the establishment of an invariable concomitance (Vyāpti, व्याप्ति) between the mark, and the character inferred. The Hindu Inference (Anumāna) is therefore neither merely formal nor merely material, but a combined Formal-Material

Deductive Inductive Process. It is neither the Aristotelian Syllogism (Formal-Deductive Process), nor Mill's Induction (Material-Inductive Process), but the real inference which must combine formal validity with material truth, inductive generalisation with deductive particularisation.

An inference admits of a rigorous formal statement,—in the shape of five propositions, for dialectical purposes (i.e., in demonstrating to others), or of three propositions when the inference is for one-self (आत्मगत):—(1) the probandum, the statement of the proposition to be established (प्रतिष्ठा, आत्मनिर्देश, e.g., yonder mountain is fiery (say, an active volcano); (2) the reason, the ascription of the mark (उग्र, सेवयनदेश).—e.g., for it smokes; (3) now, the general proposition, stating the invariable concomitance which is the ground of the inference,—clenched by an example bringing home the responsibility of the reasoner to establish a real relation, e.g., whatever smokes is fiery, as an oven; (उदाहरण);—(4) next, the application, the ascertainment of the existence of the mark in the present case (उपमा) e.g., yonder mountain smokes;—(5) finally, the conclusion, the probandum proved (विवरण), e.g., yonder mountain is fiery.

1. Yonder mountain is fiery.
2. For it smokes.
3. Whatever smokes is fiery, as an oven.

4. Yonder mountain does smoke.

5. Therefore, yonder mountain is fiery.

For inference for oneself, only the first three or the last three propositions, are held to be sufficient.

The Hindu Anumâna, it will be seen, anticipates J. S. Mill's analysis of the syllogism as a material inference, but is more comprehensive;—for the Hindu Udarâhâraṇa, the third or general proposition with an example, combines and harmonises Mill's view of the major premise as a brief memorandum of like instances already observed, fortified by a recommendation to extend its application to unobserved cases, with the Aristotelian view of it as a universal proposition which is the formal ground of the inference. This Formal-Material Deductive-Inductive process thus turns on one thing—the establishment of the invariable concomitance (*सम्बन्धः*) between the mark and the character inferred,—in other words, an inductive generalisation. The question is—what is our warrant for taking the leap from the observed to unobserved cases? Under what conditions are we justified to assert a Universal Real Proposition on the basis of our necessarily limited observation?

The Chârvâka view:—Among the Chârvâkas there were two classes, the cruder school of materialists who accepted perception (*विद्या*) as a valid source of knowledge, as well as the reality of

Natural Law (व्याप्ति), and the finer school of sceptics, who impugned all kinds of knowledge, immediate as well as mediate, and all evidence. Preception as well as Inference, *vide* Jayanta's reference in the Nyaya-Manjari to व्याप्तिसमावेशाः; also चार्यावधारस्य व्याप्तिसमावेशाः व्याप्तिसमावेशाः व्याप्तिसमावेशाः—A'hnika I, Manjari.

The Chārvākas hold that the principle of causality, which the Buddhists assume to be a ground of an induction (व्याप्ति) is itself an induction (a case of Vyāpti!), which amount to reasoning in a circle (व्याप्तिसमावेश); that every inference is based on an unconditional invariable concomitance which itself must be inferred, as universal propositions cannot be established by our limited preceptions, and thus there is a regressus ad infinitum (व्याप्तिसमावेश); and that the nexus between cause and effect, or between the sign and the thing signified (e.g., smoke and fire) is only a mental step or subjective association based on former perception, a mental step which by accident is found justified by the result in a number of cases.

The Buddhists—their Analysis and Vindication of Inference :— The Buddhists, however, take their stand on the principle of the Uniformity of Nature (सत्यता, अभाव इत्यत्त्व, Nyaya-Vindu). This uniformity, for scientific purposes, has to be divided into two different relations,—(1) the uniformity of succession in the relation of cause and effect, e.g.,

of smoke to fire (वार्षिकारपत्र, न्यूनपनि, Nyaya-Vindu); (2) the uniformity of co-existence (in the form of co-inherence in the same substrate) in the relation of genus and species, e.g., the relation of invariable concomitance expressed in the proposition,—all Sinsapis are trees,—which is not a relation of causality, but of co-existence or co-inherence in the same substrate (i.e., the co-inherence of the generic qualities of a tree with the specific characters of a Sisu tree, in this particular individual before me, a Sisu tree),—a relation which may be termed essential identity (वार्षिकी, समान—Nyaya-Vindu). To these two, the Buddhists add a third ground of inference, non-perception of the perceptible (व्युत्पत्ति दृश्यानुपर्याप्ति), which is employed in inferring the absence (प्रतिवेद्य) of a thing from the non-perception of something else. In all cases of inference based on the Uniformity of Nature, the relation is that of inseparableness or non-disjunction between the mark and the character inferred. The question is—how is this inseparableness (विनामात्र) ascertained, and what is the warrant of our belief in it, in these cases?

Ascertainment of Inseparableness or Non-disjunction : Buddhist Account :— First take the case of causation. The cause is the invariable antecedent of the effect. What is meant is that the specific effect (with all the distinctive and relevant accompaniments, वार्षिकी) is invariably preceded by a

specific cause (प्रकृतिशील). It is not that clouds always lead to rain, or that floods in the river valley always imply rain in the hills higher up. But this particular conjunction of antecedent circumstances (e.g. the appearance of a particular kind of clouds accompanied with flashes of lightning, the roll of thunder and flights of Valakus—driven by the wind from a particular quarter of the horizon, and ascending in black masses, etc.) is as a rule the precursor of a particular assemblage of rain effects (rain with particular accompaniments). Again, this particular kind of flood (overflowing of the river banks accompanied with muddy discolouration of the water, rapid currents, the bearing down of tree trunks, etc.) is always preceded by rain in the hills higher up (though, no doubt, other case of floods in a river may be due to a breach in an embankment or the melting of the snows). In other words, the Buddhists (and the earlier Nyaya Schools) avoid the difficulty arising from the plurality of causes by taking into consideration the accompanying phenomena, which, if properly marked, would always point to a specific cause of a specific effect.

I quote Nyaya authorities, but this device to obviate the plurality of causes is common to the early Nyaya and the Buddhistic systems.

पूर्ववदः ॥ एष कारणेन कार्यमनुभोवते ॥ उदाहरणम्—

सेवोऽप्या भविष्यति इच्छिति कारणेन कार्यानुभावम् ॥ एष

पुराण गीतः। इटितः एवं मेषः वचोरज्जनिवसे रवि वहस्याका-
वस्ते सति चविरप्रभावस्ते सति उप्रतिमज्जान् इटित्वे चवन्।

विषद् (यद कार्यक वारसमनुसीरते)—उद्योतकृष्ण—

उपरिहाइटमहे प्रस्तवाभ्यमी नदीबोतः श्रीप्रभे सति पूर्वपक्षकाहादि-
वहस्ये उति पूर्वलात् पूर्वादिमवदीवदिति । (Uddyotakirna,
Chap I. A'hnika 1, Sutra 5). Vachaspati puts this
clearly :—यद्यपि वारसमाते अविचरति कार्यात्पादं तदापि वाहस्य
न अविचरति तथा निपुणे अविषयका अवित्तवाम् । अवशा चूम्यावस्थपि इडि-
मता अविचरतीति न खुम्बित्वे दमकी नवेत् । In other words,
a single condition called a cause is not invariably
succeeded by the effect, nor does the effect
phenomenon in general point to any particular
cause as antecedent, for there may be a plurality of
causes of a general effect. The skilful observer
will therefore select the full complement of
causal conditions, which is invariably succeeded by
the effect,—and also the specific effect (e.g., वाहस्यं)
which points to a specific causal antecedent.
Compare also Jnyanta :—we infer an effect from a
specific assemblage of causes—य च वारसमावस्था उत्तुः इति
देवात्म अविचारः आन् । चपि च विविहमेव वारसं उत्तुः । य च
वारसदिवेदो दुरवस्थः । वचोरज्जितारवनिभिरविचक्षराः रीवस्य-
मवस्यावस्तमावस्थितिषः...हाई अविचरतीति द्वय प्राप्तः पदोमुक्तः ।
चन्द्रपदमि देवमनुमावस्था श्रीवित्तम् । य आदृतविदेवावस्थपि शीहुव-
वित्तः । Similarly we infer a specific cause from
a specific assemblage of effects :—इवदिति द्वय कार्यं

कारणमनुभीवते वा नदोपर्येष उपरित्वं द्वे भावस्ति । इत्यत्-
उपरित्वं च एव । एव नदो यंत्रिकमनुष्टवादिविविष्टपूरोपेतवात् । यत्
स्तु अहिमवित्तवादिवा पि नदोपर्येषतिहं दा । चति तत्त्वापि च च त—
प्रमातुरपराधीऽयं विश्वं यो न पश्यति ।
मातुरानन्द दीपोऽपि प्रमेयात्मविचारिषः ॥

(Nyāya-Manjari, Aḥnika 2, on Gotams Sūtra
5, Aḥnika 1, Chap I.)

A specific assemblage of causes, therefore, has only one specific assemblage of effects, and vice versa. Of course, the observer is to find out the essential or relevant features (as distinguished from the irrelevant ones) which, being included, will enable him to specify the particular cause of the particular effect.

Now this being premised to be the exact meaning of the inseparableness or non-disjunction in the case of cause and effect, we come to the question with which we started—how is this relation to be ascertained or established between two phenomena or assemblages of phenomena? Obviously, mere observation of their agreement in presence (चरण) and their agreement in absence (प्रतिरेष) is no help in the matter. Take a concrete example. The ass is customarily employed to bring the fuel with which fire is lighted. In a hundred cases you have observed the ass among the antecedents of smoke. In a hundred cases you may have observed that when there is no ass, there is no smoke. This is no

warrant for concluding a relation of cause and effect between an ash and smoke. It may be that you happen to have never observed smoke without an antecedent ash, or an ash without smoke following. Even this is of no avail. It is not agreement (unbroken and uniform though it be) in presence, or in absence, or in both, that can settle the matter. There is one and only one way of ascertaining the causal relation. Suppose *A* with certain accompaniments is found to precede *B* immediately. Now if *A* disappearing, *B* disappears, even though all other antecedents remain and there is no other change in the case, then and then only can the causal relation be ascertained. It is not a mere table of positive instances or negative instances (अद्वयात् न द्वयात्);—it is this method which we may term the Method of Subtraction (the Method of Difference in its negative aspect) that is the only exact and rigorous scientific Method. Such was the statement of the earlier Buddhists (cf. Uddyotakāra's and Vāchaspati's report of the Buddhist Doctrine of Inference—प इ विषयो न द्वयमापारेयः ।

कात् तादाक्षावदुत्पन्निविषयः पव विषयः । बहाह काकारक-
मावाहा अमावाहा विषयकात् । अविषयामावविषयमोऽद्वयात् न द्वयात्
—a Buddhist Kūrikā quoted in Vāchaspati, Udayana,
Sriharsha, Mādhaba, etc.)—काक्षारकमावद् इदम्—एवं
स्ति मवति—सत् एषि तदेतु एविषयति न भवति—एवमाकारः ।
न एव विषयित्वा विषयित्वा ।... (एष तादाक्षामपि विषये लाप्त

प्रत्यक्षोपयात् निवेदनम् ।...तत्त्वात् काहाकारात् तदुपर्याप्तामिव प्रतिशब्दी
काव्यः ।—Váchaspati, Tátparyyatíká, Chap I, A'bhiha
1, Sutra 5, प्रत्यक्षोपयात्—प्रतिशब्दीकाव्यः ।)

But the canon in this form is not sufficiently safe-guarded against possible abuse. Two points have to be emphasised :—(1) It must be carefully observed that no other condition is changed, (2) that the appearance and disappearance of *A* must immediately precede the appearance and disappearance of *B*. The definition of a cause is based on two fundamental characters, (1) the unconditional invariableness of the antecedence, and (2) the immediateness of the antecedence. The canon of the Method of Difference must therefore be stated in such a form as to emphasise each of these aspects. And one main difficulty in the practical application of the canon is that along with the introduction or sublation of an antecedent, some other phenomenon may be introduced or sublated unobserved. As a safe-guard against this radical vitiation of the Method, the later Buddhists formulated the canon of a modified Method, termed the Panchakárani, a Joint Method of Difference, which combines the positive and the negative Methods of Difference (the Method of Addition and the Method of Subtraction) in a series of five steps, and which equally emphasises the unconditionality and the immediateness of the antecedence as essential moments of the causal relation. This is

neither agreement in presence, nor agreement in presence as well as absence (the foundation of J. S. Mill's Joint Method of Agreement), but the Joint Method of Difference. The Panchakarani runs thus :—

The following changes being observed, everything else remaining constant, the relation of cause and effect is rigorously established :—

First step—The 'cause' and the 'effect' phenomena are both unperceived.

Second step—Then the 'cause' phenomenon is perceived.

Third step—Then in immediate succession, the 'effect' phenomenon is perceived.

Fourth step—Then the 'cause' phenomenon is sublated or disappears.

Fifth step—Then in immediate succession, the 'effect' phenomenon disappears.

Throughout, of course, it is assumed that the other circumstances remain the same (at least the relevant or material circumstances).

This Panchakarani, the Joint Method of Difference, has some advantages over J. S. Mill's Method of Difference, or what is identical therewith, the earlier Buddhist Method; and the form of the canon bringing out in prominent relief the unconditionality and the immediateness of the antecedence, is as superior from a theoretical point of view to J. S. Mill's canon,

and is as much more consonant than the latter to the practice of every experimenter, as the Hindu analysis of Anumana as a Formal-Material Deductive-Inductive Inference is more comprehensive and more scientific than Aristotle's or Mill's analysis of the Syllogism (or Mediate Inference).

But even the Panchakārani is no sufficient answer to the question with which we started. The Panchakārani is only a method; it shows only how in a particular case the relation of cause and effect is to be established (स्थापनात्मक). But we want more than this—we require a warrant for the process. The Buddhists therefore supply the following proof of the Method:—Doubt is legitimate, but there is a limit to doubt. When doubt lands you in an unsettlement of a fundamental ground of practice, and would thus annul all practical exercise of the will, the doubt must cease; else the doubt would be suicidal or sophistical. In this particular case, when the Panchakārani is satisfied, the antecedent in question must be the cause, for there is no other antecedent to serve as cause; the proof is indirect but rigid. If this be not the cause, there is no cause of the phenomenon. It was not, and it begins to be, without a cause; which would be a contradiction of the rational ground of all practice, for all volitional activity proceeds by implication on the principle of causality. If things could happen

without a cause, all our motives to action would be baffled. The link between a presentation and the instinctive volitional reaction would snap, and the circuit of consciousness would be left incomplete. In fact, the Buddhists go further; they hold causal efficiency (*कारण*) to be of the essence of empirical (relative) Reality. The proof of the Joint Method of Difference, then, lies in a strict application of the principle of causality in its negative form (viz., there can be no phenomenon without a cause) and the truth of this last is guaranteed by the same ultimate criterion of empirical (relative) Reality as the truth of Perception itself, viz., the correspondence between the rational and the practical activity of the self.

But invariable concomitance (or non-disjunction), the Buddhists argue, has another form, e.g., the relation of the genus to the species. We may have perceived a hundred instances of the association of certain characters with certain others; we may also have never perceived the former when the latter are absent; but this would not enable us to generalise and establish invariable and unconditional co-existence. We must be first satisfied that there is identity of essence (*अभ्युपाद्यता*). It is only when we perceive that the characters of a Sincapá are co-inherent with the generic characters of a tree in the same individual object (a Sincapá tree before me), and when we further

perceive that the characters are held together by the relation of identity of essences, that we can say that all Sinsapás are trees. For as there is identity of essence, a Sinsapá would not be a Sinsapá if it were not a tree. It would lose its self-identity which is a contradiction. Hence the relation of identity of essence (तादात्मा समावेश), as in the relation of the species to the genus, is the sole ground for establishing uniformity of co-existence (प्रतिष्ठान, समावेशितव्य).

(For the Buddhist Method of Induction, in its later form, the Panchakárani, vide Sarvadarsana Saṅgraha—Buddhist reply to the Chārvāka attack on Inference :—

यद्यपि चिनाभावी दुर्बैव इति तदात्मीयः । तादात्मावदुन्पत्तिभाविनाभावात् । तदुच्च—कार्यकारणाभावात् च लभावात् च विकासात् । चिनाभावभिन्नोऽहर्द्यन्तात् न दर्शनात् । As for the Nyāya view चिनाभावितिरेती चिनाभावभिन्नाती इति ।—the Buddhist objects—मतु एव वाचस्पात्यन्तीर्थविचारी दुरव्यापारः मदेत् । मृते, मरिषति, वर्तमाने चनुपलब्धान्ते च अनिवार्यात् चनिपारकात् ।—the Nyāya retorts मतु तथादिवक्त्वे तात्पत्तिःपि नन्ति अनिवारकहा दुर्बैष्टिता इति ।—the Buddhist answers—नेत्रं शीर्षं, विनावि कारणं कार्यमुनपदातात् इत्येत्तिवादः वडाणः वाचाकारविकल्पा विभूतात् । तदेव ति चार्यहेतुव चिनाभावडानाने चावातादेः चावतरेतुः । तदुच्च वाचाता-विवराभवा इति । तजात् तदुत्पत्तिभिन्नवेत चिनाभावी विशेषते । चनुपलब्धिभिन्नवेत चार्यहेतुः चक्षुषीयवस्थानुपलब्धपद्धतिव्यवहः ।

कार्यं च तप्तेः शब्दतुपत्तयः, कार्योपयाके स्वति उपत्तयः, उपत्तयम्
पदान् कारणानुपत्तयान् अतुपत्तयः इति पत्तयारस्या बून-बूनभवयी;
कार्यकारणाम् निवीयते । तस्या साहाय्यानिवैष च पि अविनाशाम्
निवीयते । कदि विद्यया उपत्तयम् अतिपत्तेन् कारणामिव अलान् इति
विपत्ते यावद्भूतेः । अहम् तु यात्रै भूवः उपत्तयोपत्तयेऽपि
अविनाशरक्षादाम् शी निवारिता । विद्ययाहृष्टो व ताहायानिवैष;
इत्येवं विद्यया इति कारणादिवरक्षरक्षान् उपपत्तेः । अलान् कार्या-
कार्यी कारणम् कारणाम् अतुपत्तयापदग्न इति विद्यम् । Sarvadarśana
Saṅgraha, Bauddha-Darsanam Vide also Sridhara
Kandali.

The Nyaya Doctrine of Inference :—The Nyaya easily demolishes the Buddhist contention about identity of essence. The Nyaya writers, being realists, do not impugn the reality of the genus (कार्य) like the nominalists or the nominalistic conceptualists ; but they point out that the inseparableness (or non-disjunction) in such cases can only be established by the experience of unbroken uniformity (अविनाशितम् i.e., by अवश्यकार्यात्, इत्यनादर्थे). Uniform agreement in presence with uniform agreement in absence,—not the mysterious identity of essence irresistibly perceived in any individual case or cases—is the only basis for constituting genera and species in Natural Classification. Indeed some of the later Nyaya writers point out that individuals do not always possess in Nature all the characters that go to form the definition of the class to which they are referred.

Similarly, as regards the relation of cause and effect, a *nexus* is sometimes fancied to be perceived, a power in the cause to produce the effect (प्रभा॒), or an ultimate form (अविशेष), which is supposed to be present, whenever the effect (quality or substance) is produced (cf. Bacon's view of the 'Forms' of Simple Qualities). All this is neither a matter of observation nor of legitimate hypothesis. There is nothing except the invariable time-relation (antecedence and sequence) between the cause and the effect. But the mere invariableness of an antecedent does not suffice to constitute it the cause of what succeeds; it must be an unconditional antecedent as well (चर्याविदिष्यत्वं नियतपूर्व-पर्याप्ता, being the definition of कारकारदधात्). For example, the essential or adventitious accompaniments of an invariable antecedent, may also be invariable antecedents, but they are not unconditional but only collateral and indirect, in other words their antecedence is conditional on something else (न कारणात्). The potter's stick is an unconditional invariable antecedent of the jar, but the colour of a stick, or its texture or size or any other accompaniment or accident, which does not contribute to the work done (so far as we are considering it) is not an unconditional antecedent, and must not therefore be regarded as a cause. Similarly, the co-effects of the invariable antecedents, or what enters into the production of these

co-effects, may themselves be invariable antecedents but they are not unconditional, being themselves conditioned by those of the antecedents of which they are effects. For example, the sound produced by the stick, or by the potter's wheel, invariably precedes the jar, but it is a co-effect,—and Akása (ether) as the substrate, and Váyu (air) as the vehicle, of the sound, enter into the production of this co effect, but these are not 'unconditional' antecedents, and must therefore be rejected in an enumeration of conditions or causes of the jar. Again, the conditions of the conditions, the invariable antecedents of the invariable antecedents, are not unconditional. The potter's father is an invariable antecedent of the potter who is an invariable antecedent of the jar, but the potter's father does not stand in a causal relation to the potter's handiwork. In fact, the antecedence must not only be unconditionally invariable, but must also be immediate (वस्तुतात् पूर्वकाकाराद्येदिन शाप्तदिने सम्भवम्). Finally, all seemingly invariable antecedents which may be dispensed with or left out, are *ipso facto* not unconditional, and cannot therefore be regarded as causal conditions ; in short, nothing that is unnecessary is unconditional ; for this class, *vide* Visvanátha —निवापकपूर्वमायिः वस्तुतात् पूर्वकात्मिन् एव प्राप्तवाच्चैः।
विष्णु (विश्वास) वस्तुतात्—Visvanátha, Siddhánta Muktávali, on Sloka 20. For example, it is the custom to point to spatial position or direction with the

fingers, but finger-pointing, though invariably present, is not causally related to the perception of direction or spatial position, because we can imagine such perception without finger-pointing, (चक्षुषादिहतवा चक्षुषा निर्देशज्ञ दिक्षुर्विद्यमन च स्वाधिष्ठातः लक्षणः, Vāchaspati, Tātparyya-Tikā, Chap. I, Āhnika 1, Sutra 5,—this shows that the doctrine of चक्षुषादिहतवा was long anterior to Gangesa).

[Visvanātha in the Bhāṣa-Parichchhedā mentions five kinds of चक्षुषादिहत, conditional antecedents—(1) यदै उपर्युक्तायः (2) यज्ञ या कारण-काहाय (पूर्वभाव), (3) चक्षुषति पूर्वादे जागै उपर्युक्तायदित्ताय, (4) अनन्तं प्रति पूर्ववर्तिकाय् चपरिकाय यज्ञ (पूर्ववर्तिता) च प्रस्तृते, and (5) चक्षुषि यज्ञ निवापक्युपर्युक्तादित्तः चतिरिक्षम् अवैत् (एतेषु यज्ञु चाप्रकाशत्वात्—Slokas 19. and 20), यज्ञ काहायेष्व चक्षुषतिरिक्षो च एः किञ् सकारणमाहायेष चक्षुषतिरिक्षो यज्ञेते चक्षुषादिहत, Siddhānta Muktāvali, loc. cit.—The Dinakarī points out that the first two cases are comprehended under the formula उपर्युक्तायदित्ते पूर्वादवर्तिरेकायादित्तम्: There are several classifications of these irrelevant antecedents (चक्षुषादिहत); I quote one of the best known].

The unconditional (चक्षुषादिहतवा) as interpreted in this comprehensive sense is a far more fruitful conception than Mill's, and is well adapted to its work—the elimination of the irrelevant factors in the situation. In the end, the discrimination of what is necessary to complete the sum of causes, from what

is dependent, collateral, secondary, superfluous or inert, (*i. e.* of the relevant from the irrelevant factors) must depend on the test of expenditure of energy. This test the Nyāya would accept only in the sense of an operation analysable into molar or molecular motion (परिष्कृत एव भौतिका व्यापारः करोन्तः—*चतोर्दशम् व्यापारौ नारि, Jayanta, Manjari, A'hnika I*) ; but would emphatically reject, if it is advanced in support of the notion of a mysterious causal power or efficiency (प्रभा). This is a peculiarity of the Nyāya—its insisting that the effect is only the sum or resultant of the operations of the different causal conditions—that these operations are kinetic, being of the nature of motion, in other words holding firmly to the view that causation is a case of expenditure of energy, in the kinetic form,—but at the same time absolutely repudiating the Sankhya conception of power or productive efficiency as metaphysical or transcendental (प्रभाद्वय), and finding nothing in the cause other than an unconditional invariable complement of operative conditions (कारणसामयी) ; and nothing in the effect other than the consequent phenomenon which results from the joint operations of the antecedent conditions (उत्तराधिकारः परिष्कृत एव—Jayanta—वानरी वाये—सामग्रीकार्यसे तु कार्यम् व्यापारात्मका व्यापार—Jayanta ibid, A'hnika, 1, प्रभानिराधरेण—it may be noted that the Nyāya, while repudiating transcendental power (Sakti) in the mechanism of nature

and natural causation, does not deny the existence of metaphysical conditions like merit (वृत्ति,) which constitute a system of moral ends that fulfil themselves in and through the mechanical system and order of Nature—vide Jayanta. चतीक्ष्य दिग्बि चारण अस्तमेव चक्षादि—A'hnika 1, अन्तिमा। चारणम्).

The causal relation, then, like the relation of genus to species, is a natural relation of concomitance (अस्ति: चालाक्षः चर्यः—Váchaspati) which can be ascertained only by the uniform and uninterrupted experience of agreement in presence and agreement in absence, and not by deduction from a certain *a priori* principle like that of Causality or Identity of Essence.

Nyāya objection to the Buddhist Method of Difference as a means of ascertaining causality.

Take for example the Buddhist deduction of Causality in any particular conjunction by means of the negative Method of Difference, or of the Panchakárani. The ascertainment of the causal relation by these Methods is open to the following objections :—(1) The unconditionality of the antecedent cannot possibly be ascertained. As the Chārvāka rightly points out, the Methods enable you to eliminate irrelevant antecedents that are or can be perceived; but the introduction or sublation of latent or undetected antecedents can be imagined against which the Method of Difference is powerless. In the case of the production of

smoke, for example, by fire,—what if I say that an invisible demon intervenes in every case between the fire and the smoke, that this demon (दैवत) is the immediate antecedent and real cause of the latter, and that the fire is an accident which, in every such case, is brought about by its own causal antecedents ;—in saying this, I do not go counter to the principle of causality and am landed in no contradiction (विवर्तन) such as strikes at the very roots of all practice, or baffles the completed circuit of consciousness, however much I may violate probability.

(2) In the second place, even supposing that the fire, in this particular case (which satisfies the Method of Difference rigidly) is ascertained to be the cause of the smoke, how can I know that fire is the cause in other cases, or that there is no other cause. You will perhaps argue that if there were an *indefinite* number of causes of the same specific phenomenal effect, it would violate the principle that phenomena are all conditioned, i.e., exist only under certain conditions (विवर्तन),—which is more comprehensive than the principle of causality, and the contradiction of which equally overthrows all rational practical activity. Yes, I accept the conditionality of phenomena, but this is not violated by supposing that one specific assemblage of phenomena has more than one cause. It is true that if you suppose such plurality of causes, you cannot establish the invariableness of

the particular conjunction (green-wood fire and smoke) which your Method of Difference fixes upon as a case of cause and effect ; in other words, with your special principle of Causality so restricted; and without any general principle of Uniformity of Nature to fall back upon, you cannot ascertain, from the present case, or from any number of similar cases that you may have observed, that all green-wood fires are followed by smoke ; i.e., you are helpless in demonstrating with apodictic certainty (or ascertaining indubitably) the relation of cause and effect. But this is an objection against your own position, not mine. Why not admit at once that certain phenomena are naturally connected (as invariable concomitants or antecedents) with other phenomena, and take your stand on observed concomitance (uniform and uninterrupted experience of agreement in presence as well as absence) without assuming causality as an *a priori* principle and making deductions therefrom, and without the trouble of ascertaining the relation of cause and effect in every individual case. I am free to admit that theoretical objections of irresistible force (like those of the Chārvāka Sceptics) can be urged against this ascertainment of universal invariable and unconditional concomitance (अविच्छिन्नता) on the basis of mere observation. Doubts of this kind can no more be laid by my view of the matter than by your canons of causality and essential

identity (तदृपति and तादात्मा). Ultimately we all have to fall back on the rational practice of thinking persons (प्रचारात्मः), and such persons are always content to act on practical certitude instead of bankering after an unattainable apodictic certainty in the affairs of life (तात्त्वाचिह्नोक्त्यात्मात्म-प्राप्तवता व्यादर्थं अहनीतम्). This same practical certitude is also the ultimate warrant of the Deductive-Inductive Inference by which we ascertain the characters of things without direct perception and through the medium or instrumentality of a mark.

[To the earlier Buddhist canon of the Method of Subtraction, i. e., the negative Method of Difference, Uddyotakara and Vācaspati of the Nyāya School pertinently and acutely object as follows :—

सर्वं वस्तु विचित् अचित् हट्टं सर्वं वस्तु वित्तिष्ठः, तदिदः तस्मा तस्मा
वस्तुष्टं वस्तु इति व्युत्पादीतः। एव परं तु वित्तिष्ठी न तात्मा तदृपत्त्या
वस्तुष्टि। का पुनरित्य तदृपतिः। चूम्या विं वड्डमन्तरं भावः। एव
वाह्यः चक्षि रात्रभक्षापि। तदृपतिवहोऽपि चूमः कात्। चर्यं तदृपत्त्या-
रमेव भावः, न च रात्रभक्षापि ममक्षपि तदृपत्त्यरमेव भवति. तचित् सति
चक्षि चक्षति चक्षी तदृपत्त्यात्। चक्षति चक्षि तचित् लक्ष्यादेशवस्तुति
पृथी तदृपत्त्यात्। चक्ष चक्षपि चूम्या विद्युत्प्राप्त्यामुविद्याम् तत्त्वोपस्थितः,
तत्त्वापि द्विक्षाकरादितु तदृपत्तीत्यस्य तुत्त्वः। तत्त्वा हि भूयो भूयो
रात्रमि हट्टे चूमो हट्टः, तदृपत्त्ये च चक्षः, न स तदृपत्त्यः। तत्त्वातीय-
संख्यं चूम्या रात्रम् दिना चक्षि चक्षी चाशात्, एवं चक्षपि चक्षी पित्राचेत्य
अविद्यी चूमः, तचिदेवादी तत्त्वातीय एव रात्रमवद्युत्प्राप्तिविद्यि पित्राच-
देव भविष्यति, इति चक्षः चक्षया भावं विद्यान्वयम् चपत्त्वात्। न च तदि

भावसार्थ नियामन्, तत्र राहगादिषु चविशेषात्। तदनन्तरमेव इति च
चक्रारब्धं बहुवाक्यभावात्। चक्रारब्धं तु बहाप्रवदे परम्परारब्ध-
प्रकृता-

Buddhist reply :—आहितम्। यी यी चूमी हटः च चर्चापन्
चाटेभवष्टुहितवज्ञानकरमेव, च पित्राचालकारं। च च चादाचित्तकला
निमित्तमेवमात्रो यदनन्तरमेव गव्यते तदित्य चक्रारब्धभिक्षारं निमित्त
करीति, च तु प्रतीतमेवमिक्षारं राहगादि। नापि चर्चाइनुपचयभिक्षा
चादिः। यदि च तदित्तमेवमिक्षारं विमाईपि चक्षुः उचित् खूमी च उप-
कल्पते। चक्र चक्षु (पित्राचः) चर्चापा चक्षुहितः तथा सति चाटेभव-
ष्टु चक्र चक्षुरपि च चारवम्। चारव चेत् चक्रं तदकरेषु खूमावज्ञाहा।
Now the phenomenon that is contingent (चादाचित्त)
cannot be uncaused—चक्रारब्धं हि चादाचित्तकला निमित्तं चक्रं
चक्रले च चात्, चक्रेवतात् च चादाचित्तकला। And with the
limitation of a specific effect, there must be only
one specific cause, for an unrestricted plurality of
causes would amount to the denial of uniformity in
causality (i. e., of the unconditional invariable
antecedence)—

नापि चक्रेषु चारवं, चक्रारब्धप्रकृतादित्। चक्रारब्धमेव आद इति हि
चूम्यते चक्रिकार्यवम्। च चेत् चक्रहेतपि चक्रकर्त, च चक्रारब्धः स्यात्,
प्रति च चक्रः चारवम्। एवम् चक्रारपि च चारवे। च हि चक्रारब्धमेव
महति, चक्रहेतपि चक्रकर्त चारवम्, तत्र चक्रहेतुको चूमः चात्। तथा च
चादाचित्तकलव्याहितः।

Nyāya rejoinder :—कृतम्। चक्रपि विमा चक्षु नोपचयो
कृतम् चक्रपि च विमाचालकरं नीप्रवदते तेजामहुपचयेः, चक्रपि पित्राच-

कार्य एव च मः । तत्र सब विद्युत् गुणविद्युत् गुणविद्युतः । रात्रम् इष्टं
न च नम् अनुभवः । तेव तदवाक्येष्वि तत्त्वातीति एव कारकभैरववाचा
कर्त्तव्यित् वादपितृकी चूमः जात् । इति चन्द्रिकान्तरिक्ष वदावाः ।
न च हृष्टव्यवहाराहृष्ट वस्त्रविद्युत् युवत् इति वाहृष्ट मर्यादिव्यवहृष्ट । चन्द्र-
चन्द्रिकान्तरिक्ष वदावाचकर्त्तव्यात् (vide Nyāya Vinda) । न च
चन्द्रपूर्ववाचकर्त्तव्य चयि तत्त्विद्युति प्रभवति । तत्त्वाद् चन्द्रकर्त्तव्य इति
चन्द्रावाचावाचात् चैव कार्यकारकमाधावदार्थं युक्तम् । न च वदव्य-
वहितावाचात् उपदेशं तद्वत्तदवर्हितात् तत्काम् भवत् तित्वातीति भवति ।
जलं हि रामभवहितात् वहृष्टः वाहृष्टो च मः लाहृष्ट एव तदर्हावात् वहृष्टे-
रिति । तत्कादिर्विद्या वहृष्टपितृकी वामिकार्यं तदुत्पत्तिनिवदाक्षम्यद्वी
न च वद्या विमार्यव्यवहृष्टम् ।

The Nyāya proceeds to point out that what is contingent need not necessarily be produced by a cause. It is enough if there is natural connection with something else, a relation of antecedence and succession (or concomitance), without any element of productive efficiency or causation.

चयि चाचु तदुत्पत्तिनिवदः तत्त्वाऽपि चत्त्वात् कारकमनरेति न कार्ये
भवति । तत्त्वा च चयि चयेवत्त्वा वादाचित्कर्त्तव्यविहितिः इति चेत् ।
चत्त्वा तर्हि चयव्यः लाभाविवदत्त्वा चयावयेषः चयमिकारी वदव्यवहृष्टम् ।
न च यो वा च वा चयव्यतु । इति कार्यकारकमाधावदावदाकामित्य । वदा-
चेत्तत् तत्त्वा चये दर्शकिकामः । Vāchaapati, Tītparyya-Tīka,
Chap. I, A'bhiha 1, Sutra 5, वामिकापादविचारः ।

The Nyāya analysis of the causal relation continued :—Co-effects — In the enumeration of dif-

ferent varieties of irrelevant antecedents (अवयाविह), we have already noticed that co-effects of the same Cause are apt to be confounded as cause and effect. In some cases, the co effects may be simultaneous, e.g., the case of the ascending and the descending scale in a balance, which are co-effects of gravity (*vide Pártha-súrathi Misra on Kumárlila, Sloka Vártika—सुन्यात्मकोऽप्यत्मवीक्षणं च निष्ठः काय्यारचनाम्, उभयीदिक्षारचनाम्—sloka 157, Súnya-Váda*). In other cases, the co-effects may be successive effects of the same cause, and here the risk is great of mistaking the antecedent co effect to be the cause of the succeeding co-effect; e.g., the case of ants moving in a line to carry their eggs upward, which is observed before the summer rains,—where the movement of ants and the rains are not cause and effect, but successive effects of the same cause, viz., the heat (ऋतु), which disturbs the elements, viz., the earth and the atmosphere (महाभूतशीम); the ants being affected by this heat earlier than the atmospheric movements which bring the clouds and the rain.

(Uddyotakara, and Váchaspati—*न च पिण्डीक्षिकाच्छब्दरूपं वर्त्तते चारचनगुणवत्तानभावात् । चहुवपि तत्पर्यात्मकीत्यपत्तेः । वर्त्तमात्रारचनं तु महाभूतशीमस्य पिण्डीक्षिकाच्छब्दरूपं पूर्वकार्यम् । इच्छाता: चतु विशिष्टाः शोषितोऽप्यथा याति चकानि शूलिङ्गानि उपरिकार् नवत्वा—Tatparyya—Tikā II, 2, Sutra 37).*

Synchronousness of Cause and Effect.—This is resolved into a case of simultaneous co-effects of the same ultimate cause, e.g., the ascent of one scale and the descent of the other in the balance, which are not related as cause and effect, but are simultaneous effects of gravity. In other cases, the synchronousness is only apparent, the interval between the antecedent and the consequent being too small (त्रुप्तात्) to be apprehended (वैष्वामिकात्) e.g., in the case of the needle piercing a hundred soft lotus petals laid one upon another, where the steps are really successive; or the illumination of the whole room by the light of a lamp, where the succession is unperceived owing to the inconceivable velocity of light (cf. Kumárlá, Sloka-Varttika,—*सुरुद्गुमता फिरं वैष्वामिकात्*.—वा इदीपश्चाद्युम्, एवादेवीर्णि तद् च। दुर्बन्ध
वा वैः वैष्वामिकता वा। Súnyaváda, Sloka 156-157.—I quote Mímanśa authorities, but the view is common to the Mímanśa and the Nyáya-Vaiseshika).

The time-relation in a chain of causes and effects:—A careful study of the time-relation in a chain of causes and effects is a peculiarity of the Vaiseshika system (and the later Nyáya). A moment (ultimate unit of time, Kshana, क्षण) is defined to be the time-interval between the completion of the sum of conditions and the appearance of the effect. The Vaiseshika conceives the unit to be determined by reference to the division

of one atom from another (विद्युतात्मप्राप्तिमात्रा विभागात्मकम् अवस्था एवं विभागात्मकः विभागः च च:—Sapta Padárthí, Siváditya ;—i.e., the ultimate unit of time is the time during which motion exists in an atom prior to its division from another atom, in a case of division due to motion). The Sánkhya, we have already seen, determines this ultimate unit by reference to the motion of a Tanmátra.

The number of such units will determine the time-interval between a given set of physical conditions and a particular effect, for between a so-called sum of causes and a so-called sum of effects, there intervenes a series of atomic (or molecular) motions, with conjunctions and disjunctions which form the causal chain. However crude in the practical application, the fundamental idea is, in connection with the principle of work and energy (for which both the Sánkhya and the Nyáya-Vaiseshika furnish a rudimentary basis), immensely suggestive of a possible Time Calculus.

Plurality of Causes :—This will be discussed, when we consider the relation of Vyápti to the principle of Causality.

The Nyáya Ground of Inference—Vyápti व्याप्ति—Vácaspati :—Inference, then in the Nyáyas, depends on the ascertainment, not of the causal relation, nor of the relation of genus to species, but of a natural relation, between two phenomena, of invariable and unconditional concomitance

(उद्योतकारः वाचस्पतिः वायः वायः—Uddyotakara and Vácaspati). Of the two phenomena so connected, one is called the Vyápya or Gamaka (the sign, mark or indicator), and the other Vyápaka or Gamyá (the thing signified, marked, or indicated). In the relation of fire and smoke, for example, smoke is the Vyápya or Gamaka (sign or mark); and fire, the Vyápaka or Gamyá (the thing signified or marked). Now the relation of Vyápti between *A* and *B* may be either unequal or equipollent विवरणीय or व्याप्तिष्ठैर्). When *A* is the sign of *B*, but *B* is not the sign of *A*, the Vyápti is one-sided or unequal, and here a Vyápti is said to exist between *A* and *B*, but not between *B* and *A*. For example, smoke is a sign of fire, but fire is not universally a sign of smoke. When, therefore, the relation of Vyápti is an unequal one, as between smoke and fire, it is expressed in the proposition :—Wherever the Vyápya (sign or mark, e.g., smoke) exists, the Vyápaka (the thing signified or marked, e.g., fire) also exists. From this it follows by necessary implication (a sort of व्याप्तिष्ठैर्) that whenever the Vyápaka (e.g., fire) is absent, the Vyápya (e.g., smoke) is also absent (व्याप्ताभावे व्याप्तिभावः). Again the Vyápti may be a mutual or equipollent one, i.e. *A* and *B* may be signs of each other, e.g. green-wood fire and smoke. Here each in turn is Vyápya and Vyápaka, and this is expressed in

the two propositions :—(1) Wherever there is smoke, there is green-wood fire, and (2) wherever there is green-wood fire, there is smoke. By necessary implication it follows—(1) where there is no green-wood fire, there is no smoke : (2) where there is no smoke, there is no green-wood fire. We have seen that a Vyápti exists between smoke and fire, for wherever there is smoke, there is fire. But we cannot say that a Vyápti exists between fire and smoke, for we cannot say that wherever there is a fire, there is smoke. The combustion of an iron-ball (वृत्तिरूप), for example, is a case of fire without smoke. But it would be correct to say that a Vyápti exists between green wood fire and smoke, as well as between smoke and green-wood fire. The question, therefore, is—What is the relation between fire and smoke ? The relation between fire and smoke is a conditional relation ; i.e., on condition that the fire is green-wood fire, it would be a sign of smoke. In other words, a Vyápti implies unconditional invariable concomitance, and the relation between fire and smoke is not therefore a Vyápti (natural unconditional concomitance), for fire requires a 'condition,' Upádhi, viz., green-wood, to be followed by smoke. Smoke, on the other hand, requires no 'condition' to indicate fire. For the purposes of Inference, therefore, relations between phenomena may

be considered as of two kinds :—(1) Contingent conditional relations, holding good on the fulfilment of a certain condition or Upádhi, and (2) Vyápti, or unconditional invariable relation, between a mark and that which it makes, a relation without any Upádhi or determining condition (व्याप्तिः उपादिः). It is this latter kind of relation that serves as the ground of Inference. If we can ascertain that a Vyápti exists between *A* and *B*, then *A* is a sign of *B*, and an inference of the presence of *B* from the presence of *A*, and of the absence of *A* from the absence of *B*, would be warranted. The question, therefore, is—how to ascertain the relation of Vyápti between two phenomena.

Ascertainment of Vyápti according to the early Nyáya (न्यायवाचीपाद).—Briefly speaking, the observation of agreement in presence (उपादि) as well as agreement in absence (अवृत्तिरूप), between two phenomena, with the non-observation of the contrary (अविकाशदर्शनम्), is the foundation of our knowledge of Vyápti (व्याप्तिः—Váchaspati). This suggests a natural relation (नामविकल्पम्—Váchaspati) of invariable concomitance (निवादादर्शम्—Váchaspati) between the phenomena, which is fortified by our non-observation (अवृत्तिरूप) of the contrary (अविकाश). But this does not establish the unconditionality of the concomitance (अविविक्तुरुपम्), which is essential to a Vyápti. We have therefore to examine the cases carefully

to see if there is any determining condition (Upādhi—i. e. some hidden or undetected but really operative or indispensable accompaniment) which conditions the relation between the supposed sign or mark (Gamaka) and the supposed signate (the thing signified, Gyanya). Now let us consider what constitutes an Upādhi. It is a circumstance which always accompanies, and is always accompanied by, the supposed signate (the thing signified, Gyanya), but does not invariably accompany the supposed sign or mark (Gamaka). If, therefore, in the set of positive instances where both the sign and the signate are present, nothing else is constantly present, there can be no Upādhi. Or, again, if in the set of negative instances where both the sign and the signate are absent, no other material circumstance is constantly absent, there is no Upādhi. This follows from the very definition of an Upādhi. It is impracticable to fulfil these requirements rigorously. Still, every one of the accompanying circumstances (of course the likely ones) may be taken successively, and it may be shown that the concomitance continues even when the suspected Upādhi (*प्रतिपादित*) is absent, and therefore it cannot be the Upādhi. And this is to be fortified by the observance of uniform and uninterrupted agreement in absence (Vyatireka) between the two concomitant phenomena. In this way, when we have disproved all

suspected Upādhis, we conclude by establishing the Vyāpti. It is true that we may still go on doubting. But doubt has a certain limit for the 'experimenter' and the thinking person (परीक्षक, प्रेरणात्मक). When doubt overthrows the foundation of all rational practices (वाक्यविवेचनव्याप्ति), or leads to a stoppage or arrest of all practical activity (स्थिरव्यवहार), it stands ipso facto condemned, and must be abandoned (व्याप्तिविराम). Sriharsha and Udayana—व्याप्ति is mentioned by Vācaspati. Thus it is that Vyāpti is ascertained. In this way, we observe innumerable instances of Vyāpti. Now by means of repeated observations of this kind (पुष्टोदयन), we have established the principle of the Uniformity of Nature (व्यभावतित्वम्), and also of Causality; and these two principles thus ascertained may be made use of in their turn as the basis of an argumentation or deduction (Tarka, U'ha, तर्क) to confirm a particular Vyāpti in a particular case. Tarka or U'ha, then, is the verification and vindication of particular inductions by the application of the general principles of Uniformity of Nature and of Causality, principles which are themselves based on repeated observation (पुष्टोदयन) and the ascertainment of innumerable particular inductions of uniformity or causality (सूक्ष्मदर्शनवित्तसंखारसिद्धितम् इत्यनेन व्याप्तिविवेचनव्याप्ति—Vācaspati). Thus Tarka also helps in dispelling doubt (व्यक्तिगतम्). Sriharsha,

however, questions the validity of this verification,—cf. the well-known couplet ending यत्प्राप्तिः प्राप्तः ।

It will be seen that the process of disproving all suspected Upādhis (प्राप्तिविवरात्), in the early Nyāya, answers exactly as a process to Mill's Method of Agreement. In fact, the disproof of a suspected Upādhi by pointing to instances of Agreement in absence (प्रवृक्ष) even in the absence of the Upādhi, fortified as this is by the instances of agreement in absence (प्रवृक्ष), virtually amounts to Mill's Joint Method of Agreement. But the fundamental difference is this :—Mill's Method of Agreement is formulated in view of the phenomena of causation (including co-effects, etc.) and, as usually enunciated, confessedly breaks down in dealing with cases of Uniformities of Co-existence unconnected with Causation ; the Nyāya Method based on the disproof of suspected Upādhis is a more daring and original attempt, and is far more comprehensive in scope, being applicable to all Uniformities of Co-existence and of Causation alike. And this the Nyāya successfully accomplished, by introducing the mark of unconditionality (प्राप्तिव्यग्यता) into the relation of Vyāpti (Concomitance), even as the same mark of unconditionality (प्राप्तिव्यहित्यता) had been previously introduced into the definition of Causality (कारणाकारणम्). The difference between the early Nyāya and the Buddhist systems

may be briefly put thus :—The former relied on empirical induction based on uniform and uninterrupted agreement in Nature, and accordingly regarded the Method of Agreement as the fundamental Method of Scientific Induction, founding Inference on Vyāpti to which they subordinated Causality in the doctrine of Method ; the latter assumed two *a priori* principles, viz., causality and identity of essence, deduced the canon of the Method of Difference by an indirect proof from the principle of causality, and made this Method the foundation of all scientific Induction of Causality, just as they based all natural classification of Genera and Species on their *a priori* principle of Identity of Essence.

[Text from the early Nyāya :—

Method of Agreement and the Joint Method without the device of the Upādhi :—

Cf. Jayanta on शास्त्रम्—सत्यम् सर्वे भवति न विद्या
प्राप्तं ततः । चक्षेत्वा दिवामारो निरूपः सहचारिता । ‘तत्त्वम् शास्त्रम्’
'only this remaining throughout,' while others change—implying the Method of Agreement. The set of positive instances, in which this antecedent alone is constant, must be supplemented by a set of negative instances (agreement in absence) :—अतिरिक्तविवरणमनुरिप्त
शक्तिवर्धनानुपपत्तेः । निरूपमार्गं उच्चते यत् तत्त्वम् सत्यं भवति ततो
विद्या न भवति इति मूलीदर्शनम् । तत् तत्त्वम् उच्चति भवति तत्त्वम् अ-

परिच्छेदात् चर्वदीली निष्ठः कात् । तसी विश्वा न अवश्य उच्चत
चर्वक च परिच्छेदात् एति Jayanta, Abnika II, अनिरिक्षणाति-
निष्ठावस्थाउच्चत् ।

**Doctrine of the Upādhi :—Unconditional con-
comitance distinguished from conditional :—**

यो वा वा चक्षु सम्बन्धः यज्ञ चक्षु स्त्रामादिको निष्ठतः एव वस्तुतः,
वस्तुत इतरः सम्बन्धीति युक्तते । तथा हि चक्षुदीला चक्षादिरूपस्थः
स्त्रामादिकः । न तु चक्षुदीला चूमादिभिः । उपस्थिते ते हि विश्वापि
चूमादिभिः । बहात् चार्देश्वादिरूपस्थम् चनुभवति तदा चूमादिभिः सह
संवर्तने । तसात् चक्षुदीलाद् चार्देश्वाद्युपादिकात् । उपस्थिती न स्त्रामा-
दिकः । तसी न निष्ठतः । स्त्रामादिक्षु चक्षुदीला चक्षादिरूपस्थ उपादिभिः
चनुपस्थवनामात् इवित् अभिवारते चहर्त्वात् चनुपस्थवनामाद्यापि
चनुपस्थवनामात् । चती निष्ठतः सम्बन्धः चनुपस्थवनामात् ।

**Conocomitance sufficient without causal ne-
xus :—**

The Buddhist objects—In Nature, everything is connected with everything else. Hence if there were no nexus of causality between antecedent and consequent, everything might follow from everything else. The Nyāya replies—You admit uniformities (of co-existence, etc.) other than causal ;—so you confess that a natural fixed order can exist without causal nexus.....

**An Upādhi, how established and how dis-
proved :—**

The Nyāya then proceeds to show how an Upādhi

is established, or how disproved by observation.—
 अप पठः अवाईवेदव विना अूलद अवावीवादी दर्शनात् आईवलो-
 पादिः अव अूले अवेदः न तु आवाविक इति विषेदते । अूलविवेदव
 तु विना विलू अवूरतवात्, उपादिमेव च अहमात्मनस वस्त्रादा-
 वानाकानावात्, विवेदकृपेव च उद्दवम अवूपवभूते अवू-
 पादात् उत्पादं च अतिवृष्टात् उचावत् अवूलुवेदात्, आवाविकः
 अवेदः अववायने ।

General Method of Induction by exhaustion
 of the Upādhi, more comprehensive than Mill's
 Joint Method :—

For the definition of an Upādhi, vide Srisharsha and
 Udayana : अवावदःवलो यः शाखदमवाप्तिः उच्चते स उपादिरितः ।
 Hence to avoid an Upādhi (which is शाखदमवाप्तिः), the constant presence of anything relevant other
 than the sign and the signate in the positive instances (of agreement in presence, अवः), and the
 constant absence of any such thing in the negative instances (of agreement in absence, अविरेतः) must
 be safe-guarded against. This amounts to Mill's
 Joint Method.

Suspicion of non-perceptible Upādhi—Limits of
 legitimate Doubt :—

न च अहमावीर्ये दर्शनामृच्छा शाखदवाववानावाभवित
 अहित्याम उपादिः आवाविकर्त्त अतिवृष्टाति इति शावदम् । अवव-
 वहवा भवित्वं निवालवावावाविति इताववाजा वलु इव
 देवाववावावित्वमेव वहा पित्रावी अवूरतरा च उपित् वालीवि निए

तत्त्वं प्रवर्तेत् । उपर्युक्ते तत्त्वादित् कर्त्तव्याद् चन्द्रस्त्र उद्भास्यताम् ।
चन्द्रस्त्रहार्षाद् देशादृष्टि निष्पत्त्वमात् । एवतः विग्रहात्रयात्रोपत्तीदेव
तत्त्वं अवश्यादिक्षयताम् । तत्त्वात् तात्त्वादित्त्वात् तत्त्वादित्त्वात्
उद्भास्यत् अहमेवम् ।.....तत्त्वाद्यादिं देवतेन विविधत्वोऽनुपत्त्वमात्मा
नाकौति चरवत्य खात्वादित्त्वं उद्भास्यत् निष्पत्त्वम् ।—

Tarka, U'tha.—Deductive verification of particular inductions by applying the two fundamental inductions of Uniformity of Nature, and Causality :—Doubt finally dispelled :—

Now innumerable particular uniformities of this kind (Vyāptis) are observed, and as a result of this repeated observation, a belief in the Uniformity of Nature (जगत्त्वादित्त्वम्), as well as in the principle of Causality (कारणादित्त्वम्) is generated in the mind, a belief which has evidential value and validity. It is not intuition (नामस्त्र) but a mental pre-disposition based on uniform and uninterrupted experience (शूलोद्धृत्यनित्यस्त्रारक्षित्वम् इत्युद्देश्य
तात्त्वादित्त्वाद्यादिः,—एव शूलोद्धृत्वम् चकार्यात् इति शूलोद्धृत्वम्). Then armed with these new resources, the belief in uniformity and in causality as general principles, we proceed to fortify our particular inductions (Vyāptis), whether of uniformity of nature or of causality, by indirect deduction from these general principles :—We argue if, under these observed circumstances, A were not the mark of B, the principle of uniformity of nature would be violated,—Nature would not be uni-

form.—or, if under these observed circumstances *A* were not the cause of *B*, the principle of causality would be violated, the phenomenon *B* would be without a cause ;—and such indirect proof (प्रतिपाद्य) gives us the overwhelming probability which we call practical certitude, and on which every reasonable man(every thinking and judging person) proceeds to act in due natural course.—
 एव भावतहातिवदा उत्तमं स्वाधेन्, यदि भावसमर्थेण भवेत्; एव भावादेव इति विवित तर्चक्षावः च विरक्षाभावसमर्थेण भवत्तदेहा एव इत्याः, तत्र विवाच्य उपस्थापयन्त्येव। Vácaspati I, 1, Sutra 5; cf. also, I, 1, Sutra 40—इतः वारचकीपदम्। उभयैव ज्ञाते। वारचापदे वार्यक चहसात्।]

Instances of Vyápti (uniformity) not comprehended under Causality, or the relation of Genus and Species :—The Nyáya points out that the relations of cause and effect and of genus and species do not exhaust the grounds of Inference. There are cases of Inference based on Vyápti (i.e., on invariable and unconditional concomitance) which come neither under Causality (प्रकृत्यपत्ति) nor under Identity of Essence ,(तादात्मा). Vácaspati notes that to-day's sunrise and yesterday's sunrise, the rise of the moon and the tide in the ocean, the relative positions of the stellar constellations, are instances of Vyápti (invariable concomitance) between phenomena which are neither related as cause and effect, nor as genus and species. Jayanta adds the conjunction of sun-set with the appearance of the stars,

of ants moving in procession (with their eggs) with the approach of the rains,—of the rising of the constellation Agnasya (Canopus) above the horizon with the drying up of rivers; of the spring tide with the full moon; and dismisses as sophistical and far-fetched the Buddhist attempt to explain all these cases by means of causality. We have seen that the Nyāya and the Mīmāṃsā reduce most of these conjunctions to cases of co-effects of the same cause, co-effects which may be either simultaneous or successive.

विषय च व्याप्तिरब्दम् चक्षुमेव विवित्सदैति, चक्षुदीप्तवस्तु
च समावस्थाप्तिम् समुद्रवर्षा॥.....॥ शास्त्राभावाप्तिः तादावर्षः च। व्याप्ति
हट्टी व्यवस्थाप्तिः ॥—Vā�aspati, Tātparyya-tśkā, I, 1,
Sūtra 4;—Cf. also Jayanta, Nyāya Manjari—व्योद्योपाधि
संनुभास्यां व्यवति हर्षनाम् । दृष्ट्यांस्त्रवस्थाप्तिम् चक्षुते तारकोदयः ।
पूर्वचक्षुदीप्तवाऽद्विरक्षुपैरवस्थाप्तिः । उदितैवानुभोदने भारतः कुचालविनः ।
द्वयतप्तिनिष्ठपैर्वत्तम् विनाशकुचपैर्वत्तम् । विषयोदिकाक्षस्त्रवार्षेषाम्
नित्याद्यः । मध्यमि परिकाः पर्वत्युटीरक्षुपैर्वत्तमाः ।

Vyāpti between Cause and Effect:—Relation of causality to Vyāpti :—

On the Buddhist (and early Nyāya) view that one specific assemblage of 'effect' phenomena has one specific assemblage of causal conditions, there would be two aggregates, the sum of causal conditions (शास्त्राभावी), and the sum of effects (शास्त्राभावी). For example, fire requires green-wood to complete the sum of causal conditions to give rise to smoke with some particular marks (पूर्णविहीन,—

वद्यवाक्यादिवर्णनम्, Jayanta II ; compare Gangesa शास्त्रानुदानविद्यानाम् वट्टकाशूलिपाच्छ्रव्यस्तात् ।— Chintāmani, Anumana, Viruddha Siddhānta). Here, between an effect and a single condition (termed a cause) there is a relation of Vyāpti. The effect is Vyāpya or Gamaka (the sign or mark); the cause (or condition) is Vyāpaka or Gamyā (the thing signified). In other words the presence of the effect indicates the presence of the causal condition, and the absence of the causal condition will by implication indicate the absence of the effect. Smoke of this particular kind is supposed to be an effect of which there is one and only one assemblage of causal conditions (fire and green-wood); hence where there is smoke, there is fire; and when there is no fire, there is no smoke.

Now introduce the complication of the plurality of causes:—Fire, for example, is the effect of several assemblages, e. g., (1) blowing on heated grass, (2) focusing rays through a lens on a combustible like paper or straw, (3) friction with the fire drill, etc. Here each assemblage is regarded as a sum of causes. But in this case there is no Vyāpti between the effect 'fire' and any particular assemblage of causal conditions, say, of the lens or the fire drill. For the presence of fire does not indicate the presence of the lens or the fire drill assemblage, nor does the absence of either of the latter in particular, indicate the absence of fire.

Indeed in such a case, the effect 'fire' is not a mark or sign (*Gamaka* or *Vyápya*) of any one in particular of the different possible causal assemblages, though each of these particular assemblages of causal conditions is a mark or sign (*Gamaka* or *Vyápya*) of fire.

The plurality of causes requires a further consideration in the light of the definition of the causal relation. A cause is defined to be the unconditional invariable antecedent. From the unconditionality, it follows that the entire sum of conditions, and not one single condition, is, properly speaking, the cause. In view of the plurality of causes, an invariable antecedent must be taken to mean that any particular cause (i. e., assemblage of causal conditions) is invariably followed by the effect,—not that the effect is invariably preceded by any particular cause.

Popularly, a single condition, say the lens or the fire-drill, is said to be a cause of fire; but, in view of the plurality of causes, this is apt to be misleading, as there is no *Vyápti* in this case: the lens or the fire-drill is no more a mark of fire than fire is a mark of the lens or the fire-drill.

The plurality of causes strains the definition of a cause, and undermines the relation of *Vyápti* between an effect and a cause. Any particular cause (causal aggregate) still indicates the effect, but not vice versa. The earlier *Nyāya* (down to

Vācaspati and Jayanta) obviated the plurality, as we have seen, by introducing distinctive marks in the effect such as would indicate a single specific cause (कार्यदेवता or कार्यमिद् indicating कारणदेवता or कारणमिद्). Some indeed went further and held that when the antecedent causal assemblages differ in kind, the effect phenomena, though apparently the same, do really differ specifically (or in kind)—कारणदेवतात् कार्यदेवताम्! But the Nyāya discards this hypothesis; the fire is the same, though the possible causes (or causal aggregates) differ, e. g., the lens, the drill, etc. But the effect phenomenon to which we attend is not the only effect;—in the case of plurality of causes, we must carefully examine the accompaniments of the effect, i. e., the sum of effects, and the examination will shew some distinctive or specific circumstance or accompaniment which will enable us to definitely determine the particular assemblage of causal conditions that must have preceded in the case under examination. This is the device of the earlier Nyāya as well as of the Buddhists, as we have seen; but the later Nyāya doubts the practicability as well as the theoretical validity of such a step on an unrestricted assumption of the plurality of causes, and feels troubled by the circumstance that no effect for which more than one cause (or causal aggregate) can be assigned, can be regarded as a mark or sign (Gamaka or Vyāpya) of any one of

the causes in particular. Accordingly, some adherents of the later Nyaya advanced the proposition that when more than one causal aggregate can be supposed for any effect, the latter is a mark or sign (*Gamaka* or *Vyāpya*), not of any one of the causal aggregates in particular, but of one or other of them ; and the absence, not of one such cause, but of each and every one of them, alone indicates the absence of the effect. A cause therefore should be defined to mean one or other of the possible alternative aggregates which, being given, the effect follows invariably and unconditionally. If we ask what is the defining mark (or quiddity) of the cause (कारणाद्वयः), we are told that it is one-or-otherness (एकत्रित्वम्), and nothing else ; others cut the Gordian knot by assuming that the different possible causes of the same effect possess a common power or efficiency (समर्थता), or a common 'form' (आविश्यक), which accounts for the production of a common effect. The latter is therefore a sign or mark of this power (भूति), or this form (आविश्यक), which is manifested by each of the causal aggregates. This hypothesis (प्रत्ययः), they hold, is simpler and more plausible than the hypothesis of specific differences latent in the apparently identical effect of a plurality of causes (कारणविश्वात् कारणेश्वात्).

(Cf. Dīnakarī on the Siddhānta Muktavāli—सिद्धान्त
मुक्तवाली इति दद्युत्कारणविश्वादोनि दद्युत्कारणविश्वादिवयेष

कारणवाद्य विद्या देव चक्रवर्त्यात् चतुर्विद्याविद्यिः । न च
दक्षपूत्रकारवीः चरितिर्विद्येवाः चाचितर्विद्याकारवदीव सम्बन्ध
कारणताप्त्वेदेवं पशुहुभिर्विद्याद्वयं कल्पिति न विद्यावार इति वाचम् ।
तत्त्वात् एवेदवदेवामध्यवक्ष्यनामपेत्वा उपमाकृत्यात् एकविज्ञानसंक्षेप
कारणताप्त्वमाता पव लभ्येत् वाचमात् इत्याहुः । ४४ ।... विद्यतम्भेत्
कारणताप्त्ववात्.....परे तु द्वचादित्यवस्थाशीलवादुक्त्योवादीतां एक-
विज्ञानसंक्षेप उत्तमाभावाद् विविद्यनाविरहात् न विद्यिसिद्धिः इत्याहुः ।
Sloka 2, cf. also, द्वचारित्यवस्थतम्भं' कारणम् विविद्यकम् ।

Cf. Udayana, Kusumānjali, Stavaka 1— वा ऽपि
द्वचारित्यविद्यी अवज्ञात्यविद्यिकातीतिः । एकविज्ञानात्
इति चेत् न । यदि हि विज्ञातीतिरु च पि एकवातीदकाव्यं कारण-व्याख्या
समवेक्ष्य, न वाचात् कारणविद्यः इतिः चतुर्विद्येवः कारणवाचम् च
न उपमातीत्येवं काव्यं स वाहारिदद्वीदेवः.....परेत् दुष्कातीत्यविद्यि
विरहम् । चर्वेत्यपि तत्कीच्छात् चूलीत्यवस्थापत्तेः ।

The Scientific Methods already noticed, the Joint Method of Difference (the Panchakāraṇi), and the Joint Method of Agreement (Vyāptigraha with Upādbisankā-nirṇaya and Tarka), are not the only methods of ascertaining causality or concomitance, or establishing a theory (विद्या) ; nor are these Methods always practicable. Very often, we reach the explanation of a fact (उपर्यग्म) by means of a Hypothesis (व्याख्या) properly tested and verified (निश्चित्र). A legitimate Hypothesis must satisfy the following condition :—(1) the hypothesis must explain the facts (उपर्यग्म, or उपर्यग्म) ; (2) the

hypothesis must not be in conflict with any observed facts or established generalisations (विद्युति ह वह वस्तु ज्ञाने, न हरित्वात्—Jayanta, Nyāya-Manjari, Ā'hnika I); (3) no unobserved agent must be assumed, where it is possible to explain the facts satisfactorily by observed agencies (यदि वह उत्तरादेष्टु न ह विद्युति वामवह वस्तु ज्ञान, वस्तु इष्टि न दृपदत्ति किं वद्यपद्यत्वमेव, *ibid*); (4) when two rival hypotheses are in the field, a crucial fact or test (विनियमण, ratio sufficiens) is necessary; the absence of such a test (विनियमनाविरुद्ध) is fatal to the establishment of either, (5) of two rival hypotheses, the simpler, i.e., that which assumes less, is to be preferred (*ceteris paribus*) (वस्तु वाक्यावध वेरुत्तु वस्तु वाक्यावधीरुद्ध); (6) of two rival hypotheses, that which is immediate or relevant to the subject-matter is to be preferred to that which is alien or remote (वस्तु प्रतिकल्प); (7) a hypothesis that satisfies the above conditions must be capable of verification (विश्वेष) before it can be established as a theory (विद्याल). The process of verification of a hypothesis consists in showing that it can be deduced as a corollary from (or is involved by implication in) some more general proposition which is already well-established (cf. Vatsyayana's exposition and illustration of Verification, विश्वेष—including both the Deductive Method and Colligation).

This doctrine of Scientific Method, in Hindu Logic, is only a subsidiary discipline, being com-

prehended under the wider conception of Methodology, which aims at the ascertainment of Truth whether scientific (Vijnana) or philosophical (Jnana) (जीवे वीज्ञान काम विज्ञान विज्ञानात् : Amara-Kosha);—the latter being the ulterior aim. In the investigation of any subject, Hindu Methodology adopts the following procedure. (1) the proposition (or enumeration) of the subject-matter (Uddesa), (2) the ascertainment of the essential characters or marks, by Perception, Inference, the Inductive Methods, etc.,—resulting in definitions (by वर्णन) or descriptions (by वर्णनाप्रयत्नः); and (3) Examination and Verification (परोक्षा and निर्देश). Ordinarily the first step, Uddesa, is held to include not mere Enumeration of topics, but Classification or Division proper (विभागः उद्देश्यप्राप्तासु उद्देश्य एषांश्चः ज्ञानावसंचया वौद्धमुद्देशः उकारमिहरवद्या वौद्धम् विभाग इति—Jayanta. Manjari); but a few recognise the latter as a separate procedure coming after Definition or Description. Any truth established by this three-fold (or four-fold) procedure is called a Siddhānta (an established theory). Now the various Pramānas Proofs, i.e., sources of valid knowledge) in Hindu Logic, viz., Perception, Inference, Testimony, Mathematical Reasoning (कल्प including Probability in one view) are only operations subsidiary to the ascertainment of Truth (सत्यावस्था). And the Scientific Methods are merely ancillary to these Pramānas themselves.

I have explained the principles of the Hindu doctrine of Scientific Method, avoiding the technicalities of Logic as far as possible; and I cannot here enter upon the logical terminology or the logical apparatus and machinery, which would require a separate volume to themselves. For these, I would refer the reader to my paper on Hindu Logic,—as also for an account of the later Nyāya (न्याय), which, in spite of its arid dialectics, possesses a three-fold significance in the history of thought : (1) logical, in its conceptions of Avachchhedaka and Pratiyogi, being an attempt to introduce quantification on a connotative basis, in other words, to introduce quantitative notions of Universal and Particular, in both an affirmative and a negative aspect, into the Hindu theory of Inference and Proposition regarded connotatively as the establishment of relation among attributes or marks ; (2) scientific, in its investigation of the varieties of Vyapti and Upādhi, (and of वृत्तिरूप) being an elaboration of Scientific Method, in the attempt to eliminate the irrelevant ; and (3) ontological and epistemological, in its classification and precise determinations of the various relations of Knowledge and Being, with even greater rigidity and minuteness than in Hegel's Logic of Being and Essence. I will conclude with a few observations on Applied Logic, i.e., the logic of the special sciences, which is such a

characteristic feature of Hindu scientific investigation. What is characteristic of the Hindu scientific mind is that without being content with the general concepts of Science and a general Methodology, it elaborated the fundamental categories and concepts of such of the special sciences as it cultivated with assiduity, and systematically adapted the general principles of Scientific Method to the requirements of the subject-matter in each case. The most signal example of applied logic (or Scientific Method) worked out with systematic carefulness is the Logic of Therapeutics in Charaka, a Logic which adapts the general concepts of cause, effect, energy, operation, etc., and the general methodology of science to the special problems presented in the study of disease, their causes, symptoms and remedies (*vide* Charaka, Vimānasthāna, Chap IV.—also Sutra Sthāna, —*vide* my Paper on Hindu Logic). Here I will give an illustration of Applied Methodology from the Sciences of Analytical and Descriptive Grammar. Patanjali, in the Mahābhāṣya, (Circa 150 B. C.) is very careful as regards Methodology. I take no note now of the philosophical presuppositions of his philology (*vide* my Paper on the Hindu Sciences of Language), but will confine myself to his presentation of the Applied Logic of Descriptive and Analytical Grammar. The sentence is the unit of speech, as every Hindu philologer contends, but the first business of Analytics

Grammar is to analyse the sentence into its significant parts and their coherent relations to one another. Assuming that articulate sounds are significant, the question is.—how is the sentence, which is the unit of articulate speech, broken up into significant words and their mutual relations? Patanjali answers that this is done by an instinctive use (cf. Vāchaspati's वृत्ति शब्दसंख्यारम् प्रस्तुवन्) of the Joint Method of Difference (combined Addition and Subtraction), fortified by the Joint Method of Agreement (प्रस्तुवन्ति). Patanjali starts with a simple case. Take the two sentence-units :—Pathati (he reads) and Pachati (he cooks). Suppose you start with the assumption that these sounds are significant, and that separate elements have separate meanings. Then you hear Pathati, and, at the same time, a man reading is pointed at. Then the assemblage of sounds Pathati (i. e., Path+ati) stands for the assemblage—'one reads,' (i. e. the action reading + an individual agent). Similarly by finger-pointing or other indication, you find that the assemblage Pachati i. e., Pach+ati stands for the assemblage 'one cook's' (i. e. the action cooking + an individual agent, say, the same agent as before).

Now look at the grouping :—

Path+ati = reading + one agent.

Pach+ati = cooking + one agent.

From repeated observation of similar groupings, one is led to conclude that Pach is the invariable concomitant of the action 'reading', because the disappearance of the former (the other element remaining) leads to the disappearance of the latter (a rough Method of Difference by subtraction—**ज्ञातसि**) ; that Pach is the invariable concomitant of the action 'cooking' because the introduction of Pach (with nothing else added) leads to the introduction of the action 'cooking,' (a rough Method of Difference by addition,—**जपत्वावसि**) ; and that Ati, which is the only 'common antecedent' (**प्रकृती**), is the invariable concomitant of 'one agent' which is the only common 'consequent' (**प्रकृती**). In fact, the last should come first by the Method of Agreement, then the other two either by Residue, or by Joint Agreement in presence and absence (**प्रयत्नसिद्धिरेति**). So far all is plain sailing, though only very simple and very rough applications of the Methods are given. But—and this is the point—throughout the argument, it is assumed that one sound is the concomitant of one idea, in other words, there is no plurality of causes to vitiate the application of the Method of Agreement in the above example. And now the objection is advanced that this basal assumption is untrue. The same sound is not the concomitant of the same idea. Different words (sounds) may have the same meaning, and the same word (sound) may have

different meanings. We cannot therefore by the Joint Method of Agreement (सम्मतिरूपी) determine the meanings of words, or the separate functions of roots (stems) and inflections,—at least not so simply as is pretended above. Patanjali states this difficulty in the way of applying the Scientific Methods to the problems presented by Analytical Grammar, a difficulty arising from the plurality of causes, but does not state the solution. The solution, however, depends on the Method of subtraction and addition (Patanjali's शीर्षी and उपशासनी). For it will be found by extensive observation that the number of meanings of which a word (sound) may be capable is limited. So also is the number of words (sounds) expressive of a given meaning. Hence, by the Method of Difference, etc., the causal relations of words and meanings may be determined. Patanjali thus established the doctrine of Prakriti and Pratyaya (roots and inflections), with their separate significance, which is of course a necessary postulate in the case of an inflectional language like Sanskrit. Isolating and Agglutinative languages offer less difficulty, whereas the difficulties are in some respects enhanced in the case of languages with a polysynthetic or incorporating (incapsulating) morphological structure.

कर्तुमार्गं देते कर्तुमार्गं यत्प्रवाहं तति । सम्मतिरूपाभासम् ।
कोऽहो वद्यो वातरैको या । एष प्रवतीक्ष्मे विवित् वद्यः वृत्तिः

पट्टीतुते चकित् चक्षी होते (पृष्ठ),—चकित् उपजावते (पठ),—
चकित् चक्षी (चक्षि);—चर्चाइपि चकित् होते (चिल्हितः),—
चकित् उपजावते (पठितिका),—चकित् चक्षी (कर्त्त्वं चेतत्प्र)।
तेऽपि चक्षामहे यः चक्षो होते, तस्मा चक्षी चक्षः योऽप्येहो होते। यः चक्ष
उपजावते तस्मा चक्षी चक्षः दीप्ते उपजावते। यः चक्षोऽप्येहो तस्मा चक्षी
चक्षः योऽप्येहो चक्षी ।

विषम उत्तरातः—यद्यो हि चक्षा पञ्चार्थं मर्ति । तद्यथा इदः
चक्षः पुरुष्टरः। एव चक्षो चक्षः। तद्यथा पञ्चः पादा भासा इति ।
चक्ष चिं च साधीशीद्युपत्ता विषमा मर्ति । नापि दूसोऽप्येहो। य
हिष्पतोति । चकिता हि चक्षता चक्षवस्तिरैकामामेव । तद्युप
पत्तद्युपपक्षयोः चक्षः पञ्चार्थं इति । (Mahābhāṣaḥyā, 1—3, 9.)

Patanjali not only applies the Scientific Methods to the foundations of Grammatical Analysis, but also by their means establishes and elaborates the fundamental categories and concepts of Grammatical (and Philological) Science, e. g., the concepts of action (क्रिया), agent (कर्ता), instrumental cause (उपकारकतमग्), end (उपलिङ्ग), origin (उत्तरा) limit (चक्रित्) substance (द्रव्य), quality (गुण), and genus (जाति);—also of the fundamental relations (at the bottom of all thought and speech)—the relations of Time (कालिकालमात्र), of space (दिश्मिकालमात्र), of causality (कार्यकारकमात्र), of inference (उत्पत्ति), of co-inference (सामान्याविकारमात्र), of substance and attribute (संज्ञाकर्त्तव्यमात्र), of the sign and the signate (संज्ञाकर्त्तिमात्र), of mutual dependence (उपरीतरात्रम्);—an entire grammatical (and philological) apparatus, which will serve as a *point d'appui* for generations of philologists and grammarians to come.

ADDENDA.

(BY PRINCIPAL BRAJENDRANATH SEAL.)

Empirical Recipes from Varahamihira (circa 550 A.D.) relating to Chemical Technology.

A. Searing of hard rocks to enable them to be cut (or pulverised) (*shuntha*).

Sprinkle on the rock taken red-hot from the fire of Palasa and Tinduka wood (*Butea Frondosa* and *Diospyros Embryopteris*) :—(a) diluted milk, or (b) a solution of wood ashes (the ashes of the *Mokshaka* mixed with those of reeds), or (c) a decoction of (the fruit) of the jujube (*Zizyphus Jujuba*) kept standing for 7 nights in a mixture of whey, vinegar and spirits, in which *Kulattha* (*Dolichos Uniflorus* or *Biflorus*) has been steeped, or (d) a solution of the ashes of the *Nectma* bark and leaves (*Azadirachta Indica*), the sesame pod, the resinous fruit of the *Diospyros Embryopteris*, and the *Guduchi* (*Tinospora Cordifolia*) with cow's urine. Repeat the process seven times (in the last case six times).

(*Varahamihira, Vribat-sanhita, Chap. 33,*
Slokas 112-117).

B. Hardening of steel (वृत्तिम्).

(1) Plunge the steel red-hot into a solution of plantain-ashes in whey, kept standing for 24 hours ; then sharpen on the lathe.

(2) Make a paste with the juice of the Arka (Calotropis Gigantea), the gelatine from the horn of the sheep, and the dung of the pigeon and the mouse ; apply it to the steel after rubbing the latter well with (sesame) oil. Plunge the steel, thus treated, into fire ; and when it is red-hot, sprinkle on it water, or the milk of the horse (or the camel or the goat), or ghee (clarified butter), or blood, or fat or bile. Then, sharpen on the lathe.

(Varāhamihira, वाराहमीहिरा,

chap. 49, slokas 23-26.

C. Preparation of cements (for rocks, metals, etc.) (वृत्तिप्रय)—

Varāhamihira gives the following recipes among others. (1) First, prepare a levigated powder with lac, the resinous exudation of the Pinus Devadara, the Balsamodendron Mukul, the Feronia Elephantum, the kernel of the fruit of the Aegle Marmelos (the bel), the Diospyros Embryopteris, the Neem (*Azadirachta Indica*), the Mhow (*Bassia Latifolia*), the Indian madder (*Rubia Manjistha*), the Phyllanthus Emblica, and the resin of the Sala tree (*Shorea Robusta*), then make a decoction of this in 256 Palas of water reduced

by boiling to 32 Palas, and apply the decoction hot.

(2) The horns of cows, buffaloes and goats, asses' hair, buffalo's skin, with gavya (cow's urine etc.), the Neem (*Azadirachta Indica*) and the *Feronia Elephantum*, similarly treated.

(3) A mixture of eight parts of lead, two of 'bell-metal' and one of brass, melted and poured hot (Maya's cement).

The first, it will be seen, has lac, gum and turpentine as principal ingredients, the second makes use of gelatine, and the third is a metallic cement.

D. Nourishment of Plants :—(from Varāhamihirīa, Chap. 54, on वृग्येण).

The most suitable ground to plant in is soft soil that has been sown with the *Sesamum Indicum*, and dug up or trodden over with the sesame in flower. Grafts should be smeared with cowdung. For transplanting, the plants should be smeared with ghee (clarified butter), sesame oil, the honey of the Kshudra variety of the bee, the oil of the Usira (*Andropogon Laniger* or *Andropogon Citratum*), the Vidanga (*Embelia Ribes*), milk and cowdung. Trees should be planted at intervals of 20 or 16 cubits.

As a sort of general prophylactic, mud kneaded with ghee (clarified butter) and Vidanga, (*Embelia Ribes*) should be applied to the roots, after which

milk diluted with water should be poured. As a remedy against barrenness, a hot decoction should be made of Kulattha (*Dolichos Uniflorus* or *Biflorus*), Masha (*Phaseolus Roxburghii*), Mudga (*Phaseolus Mongo*), Tila (*Sesamum Indicum*), and Yava (barley); which, when cooled, should be poured round the roots.

To promote inflorescence and fructification, a mixture of one A'dhaka (64 palas) of sesame, two A'dhakas (128 palas) of the excreta of a goat or sheep, one Prastha (16 palas) of barley powder, one Tula (100 palas) of beef, thrown into one Drona (256 palas) of water, and standing over for seven nights, should be poured round the roots of the plant. The measures given are for one plant.

To ensure inflorescence, etc., the seed before being sown should be treated as follows:—The seeds should be taken up in the palm greased with ghee (clarified butter), and thrown into milk;—on the day following, the seeds should be taken out of the milk with greased fingers, and the mass separated into single seeds. This process is to be repeated on ten successive days. Then the seeds are to be carefully rubbed with cowdung, and afterwards steamed in a vessel containing the flesh of hogs or deer. Then the seeds are to be sown with the flesh, with the fat of hogs added, in a soil previously prepared by being sown with sesame and dug up or trodden down.

To ensure the formation of Ballaris (i.e., sprouting and the growth of luxuriant stems and foliage), the seeds should be properly soaked in an infusion of powdered paddy, Masha (bean), sesame and barley mixed with decomposing flesh, and then steamed with Haridra (turmeric). This process will succeed even with the Tintidi (*Tamarindus Indica*). For the Kapittha (*Feronia Elephantum*), the seeds should be soaked for about two minutes (lit. such length of time as it would take one to make a hundred rhythmic claps with the palms ~~striking~~ in a decoction of eight roots (*A'aphota*, *A'maleki*, *Dhava*, *Vasika*, *Vetasa*, *Suryavalli*, *Syama* and *Atimukta*, i.e., the Jasmine, the myrobalan, the Grindel *Tomentosa*, the *Justicia Ganderussa*, the *Calamus Rotang*, the *Gymndropis Peutaphylla*, the *Echites Frutescens*, and the *Dalbergia Oujeinensis*) boiled in milk. The seeds should then be dried in the sun. This process should be repeated for thirty days. A circular hole should be dug in the ground, a cubit in diameter and two cubits deep, and this should be filled with the milky decoction. When the hole dries up, it should be burnt with fire, and then pasted over with ashes mixed with ghee and honey. Three inches of soil should now be thrown in, then the powder of bean, sesame and barley, then again three inches of soil. Finally, washings of fish should be sprinkled, and the mud

should be beaten and reduced to a thick consistency, then the seed previously prepared should be placed in the hole under three inches of soil, and fish-washings poured. This will lead to luxuriant ramification and foliage, which will excite wonder. The Agniparkna adds that the mango is specially benefited by cold fish-washings (अग्निपर्कन शोषण वाराणी उप रस—अग्निपर्कन). It will be seen that these elaborate recipes are empirical contrivances for supplying the requisite nitrogen compounds, phosphates and bacteria, those being potentially contained in the mixtures and infusions prescribed.

SANSKRIT TEXTS.

САКТЫ НАУРКУ?

С. А. САДКОВ

Extracts from RASARATNAKARA.

नामार्जुन-विवितात्

रसरत्नाकरादुच्चाः स्त्रीवाः ।

पथ महारसशोधनं व्याख्याप्तामः ।

किमद्व चित्रं यदि राजवत्तेकं

ग्रिरोक्षपुष्पाद्भरतेन भावितम् ।

सिंहं सुवर्णं तदणाकं सुखिभं

करोति गुच्छाश्वतमिकगुच्छवा ॥ १ ॥

राजावत्तेशोधनम् ।

किमद्व चित्रं यदि पीतगन्धकः

पत्ताश्वनिर्वाच्चरतेन शोधितः ।

आरस्यकैषत्पत्तकैषु पाचितः

करोति तारं चिपुटेन काशनम् ॥ २ ॥

यन्त्रकर्म्मिः ।

किमव चिवं रसवो रसेन

• • • • ।

क्षमेष ज्ञात्वाम्बुधरेष रज्जितः

करोति शूलं विपुटेन काष्ठनम् ॥ १ ॥

रसवशोषनम् ।

किमव चिवं दरदः सुभावितः

परीनां मेषा वहुशोऽस्त्रवर्गेः ।

सितं सुवर्णं चहुवर्णभावितं

करोति साचाहरकुहमप्रभम् ॥ ४ ॥

दरदण्डिः ।

तुहत्यकोद्रवकाये नरमूचेष पाषयेत् ।

वेतसादस्त्रवर्गेष दस्ता चारं पुट्यम् ॥ ५ ॥

किमव चिवं कदलीरसेन

सुपाचितं सूरषकम्दस्तम् ।

* Agrees nearly with Rasiñava ; cf. Vol. I. Sans. Texts, p. 13.

† एवडा is the correct form.

वातारितेस्तेन दृतेन ताप्यं

पुटेन दम्धे वरशुहिमेति ॥ ६ ॥

मार्चिकशोधनम् ।

हिगुणा विमला पद्या रक्षातोयेन संयुता ।

स्त्रवयैवेकं दुर्घेन ताम्रपद्माणि सेपयेत् ॥ ८ ॥

प्रम्लो मन्त्रप्य निर्गुण्डोरससिङ्गानि सप्तधा ।

मामान वसुरसेनैव शुखशुहिभविष्यति ॥ १० ॥

परतः मर्व्वलोऽशोधनम् ।

चक्रवेतसधान्याच्छमेयोतोयेन शुष्यति ॥ ११ ॥

विमलशुहिः ।

चपक्षाद्या धातवः सर्वे जम्बोरसभाविताः ।

शोधितास्त्रिदिनं पञ्चमृत्तिकाभस्मावर्णः ।

संयुताः संशोधयन्ति पुटपाकेन काञ्चनम् ॥ १२ ॥

इमश्चोवनम् ।

कार्गेन चारसाजीन आपितं शुहिसूच्छति^{*} ।

* The text reads शुहि, which is incorrect.

† This verse also occurs in Rasārnava.

तारं विवारनिचितं पिश्चाचीतैश्चमध्यगम् ॥१३॥
तारमुद्दिः ।

अहो नु चिक्रं पूर्विष्वेन
चारिष्वं मेषीपयसा छृतेन ।
तैलेन शुद्धं द्रृतष्वोऽग्नांभं
भवेत् शुस्तं शगिनृहृसिभम् ॥१४॥

मोक्षमारोटपालाय-चारगोमूर्च्छावितम् ।
वज्राकम्बिश्चाकस्क-कलन्तुकसमन्वितम् ॥२३॥
तत्परस्कं कण्ठकं साक्षाच्चूर्णं वैक्रामास्त्वयम् ।
सारघेष* समायुक्तं मेषश्चृहौद्रवान्वितम् ॥२४॥
पिञ्जितं मूर्कमूषासां धामितच्च इठामिना ।
तत्वैव पतते सस्तं वैक्रामास्त न संशयः ॥२५॥
वैक्रामास्त्वम् ।

चोदं गन्धर्वतैलं सष्टुतमभिनवं
गो रसं मूर्ककच्च

* These couplets also occur in R. R. S., with this difference that in the latter वर्षार has been substituted for चारिष्व.

भूयो वातारितेष्वं कदत्तिरसवुनं
 भावितं कान्तितसम् ।
 मूषां सत्वा॑मिवर्णमहचक्रनिभा॑
 प्रचिदिक्षाचिकेन्द्रं
 मस्तं नागीष्टतुष्वं पतति च सहसा॑
 सूर्यवैज्ञानिकाभम् ॥ २५ ॥ ०
 महाहृषाक्षोराभ्यां खोस्त्रव्येन सुभावितम् ।
 मूषायाममिवर्णयां द्रवेसार्यं न सग्यः ॥ २६ ॥
 कहुठटहृषाभ्यास्त ताप्यं खोस्त्रव्यमहितम् ।
 यद्वाकस्ते निषतति मस्तं मूषा तु अमिवत् ॥ २७ ॥
 वार्जिकं वहुशस्त्रियं ताप्यस्तु कटविकम् ।
 हत्वाम्बुध्यां पहुं ववृपायसभावितम् ॥ २८ ॥
 यहृधूमं हृतं छोडं संयुतं पुनरेव च ।
 धामितं मूलमूषायां शशिश्वनिभं भवेत् ॥ २९ ॥
 कदलौरसग्यतभावितं हृतमध्येरक्षतेनपरिपक्षम् ।
 ताप्यं सुखति सस्तं रसकष्वैव द्रिसहाते ॥ ३० ॥
 माचिकसत्वपाननविधिः ।

* Cf. Rasarnava. Vide Sans. Texte, Vol. I., p. 12

चारस्त्रेहैष धान्याच्चे रसकं भावितं वहु ।
 ऊर्ध्वा क्षात्रा तदा पथा भूलता धूमसंयुतम् ॥११॥
 मूकमूषागतं धातं टहृषेन समन्वितम् ।
 सस्त्रं कुटिलसहायं पतते नाव संशयः ॥ १२ ॥०
 रसकसस्त्रम् ।

विमलं शिश्रुतोयेन काञ्छीकामौस्तहृषेः ।
 वज्रुकम्बसमागुलं भावितं कदलीरसेः ॥ १५ ॥
 माञ्छीकक्षारसंयुलं धामितं मूकमूषके ।
 मस्त्रं चन्द्राकंसहायं पतते नाव संशयः ॥ १६ ॥†
 विमलसस्त्रम् ।

दरदं पातनायक्षे पातितक्ष जमाशये ।
 सस्त्रं सूतकमहायं वायते नाव संशयः ॥ १७ ॥
 दरदसस्त्रम् ।

गन्धकक्ष प्रभादेष मस्त्रभूयं सुभावतः ।

* Cf. Raṣṭrava, Benares MS. V. 37—38.

† Cf. Sāra, Texts, Vol. I. p. 12. R. R. S. Bk. ii.
103—104.

ततः स्यातं महासत्त्वं रसेन्द्रस्य समं ततः ॥ ३८ ॥

अभकादिस्य पातनविधिः ।

• • • •

एक एव महाद्रावो पार्वीतो नाथ मध्यवः ।

किं पुनस्त्रिभिः संयुक्तो वेतसाक्षात्काञ्चिकैः ॥ ५० ॥

मुष्काफलानि सप्ताहं वेतसाक्षेन भावयेत् ।

पुटपाके तत्यूर्णे द्रवते सुनिलं यथा ।

कुशते योगराजोयं रद्वानां द्रावये परम् ॥ ५१ ॥

अभकादिद्रुतपातनविधिः ।

तालेन वज्रं दरदेद तौस्तं

नागेन हेमं शिलया च नागम् ।

गन्धाशमना चेव निहन्ति शुल्पं

तारस्त माद्योकरसेन हन्यात् ॥ ५२ ॥

• • • •

शुल्पम् अजाओरसुगन्धकेन

तारं खुडीचोरसुमाञ्चिकेण ।

यद्यस्त धातोर्विहितस्त शुल्पं

निहत्वातं कायितस्त तौस्तैः ॥ ५४ ॥

• • • •
॥ १ ॥ त्रिविद्या विद्या विद्या विद्या ॥
विद्या विद्या विद्या विद्या विद्या ॥

• • • •
॥ २ ॥ विद्या विद्या ॥

॥ ३ ॥ विद्या विद्या विद्या विद्या ॥
विद्या विद्या विद्या विद्या ॥
विद्या विद्या विद्या विद्या ॥
विद्या विद्या विद्या विद्या ॥

॥ ४ ॥ विद्या विद्या विद्या विद्या ॥

॥ ५ ॥ विद्या विद्या विद्या विद्या ॥
विद्या विद्या विद्या विद्या ॥
विद्या विद्या विद्या विद्या ॥
विद्या विद्या विद्या विद्या ॥

128|| ԿՈՎԵՆԱՇԽԵՐ ՇՀԵՎԵՎԵԼ
118|| : ԱՐԵՒԹԵՅՈՒՄ ԻՆՉ ՏԲԵՎՈՅ
1 ԿՐՈՒՐ ԽԵՎԵՐ ԱԿԲ ԱՆԴԱ
1 08|| ԿԻԿԵՆԴՀ ԿՐՃԻ ՄԱՆԵԿԵՆԴՀ
1 ԿՐԵՎԵՎԵԼՄԵՐ ԸՆ ԽԵՎԵՐ

यावहवत्तमायाति तस्यात् तं विनिश्चिपेत् ।
पुटे वा कट्टौपदे सिंहं पर्यटकारसम् ॥८६॥
हितीयपर्यटोरसः ।

प्रणिपत्य सर्वदुषान्

(सद्बोधान्) सकलदोषनिर्मलान् ।
वस्ते सर्वहिताय
कच्छापुटं मर्वमिहि करम् ॥
त्रीयैस्तप्त्वतस्यायो सिंहो नागार्जुनो महान् ।
सर्वसत्त्वोपकारो च सर्वभाष्यमर्माद्यनः ॥
प्रार्दितो ददते शोष्य यज्ञ पश्चति याद्यम् ।
ददा स्वागच्छ भोगच्छ सूक्षकच्छ प्रसादतः ।
सर्वसत्त्वादयावेधो स्वरसेन तद्येव च ॥
तेषां मध्ये प्रधानच्छ रद्धघोषः प्रचारकः ।
छताच्छसिपुटो भूत्वा नागार्जुनपुरः स्थितः ।
एच्छते रसकर्माचि विद्यादानं ददस्त मे ॥

ओनागार्जुन उवाच—

माधु माधु महाप्राप्त तुष्टोऽहं भक्तवस्त्रमः ।
कथयामि न सन्देहस्तथा परिमुच्यताम् ॥

वस्त्रोपलितनायच तथा कालस अंसनम् ।

यथा सोहे तथा देहे चर्मते नाच संशयः ॥

• • • •

सत्साना भोजनार्थाय साधिता वटयक्षी ।

दादशानि च वर्णाणि महाक्लेशः छातो मया ॥

तत्कालहृष्टद्रव्याणां दिव्या वाची मया त्रुता ।

अहृष्टप्रार्थिता पयाहृष्टा त्वं भव साक्षतम् ॥

ओवटयक्षीखुवाच—

साधु साधु महासिंह • • •

किंचित्प्रार्थय मे सिंह तत्परं प्रददाम्यहम् ॥

त्रीनागालुँ न उवाच—

यदि तुष्टासि मे देवि सर्वदा भक्तिवक्त्वे ।

दुर्लभं चितु लोकेषु रसवन्वं ददत्तम् मे ॥

ग्रासिवाहन उवाच—

सुवर्णगदभास्तारं कुमारी मदसुन्दरी ।

निवेदितां मयाङ्गा मे आदेशो देवि दीयताम् ॥

साधु साधु महापात्रं ममादेशप्रपातक ।

साधयामि न सन्देहो बुद्धस्त्वेन साधकम् ॥

पुनरन्तं प्रवक्षामि मारुषेन यथा छातम् ।
 रसोपरसयोगेन सिंहं सूतं सुसाधितम् ॥
 विहश्यस्यायनं नागं यदार्दकासुनं छातम् ।

• • • •

शास्त्रं वशिष्ठमारुषं गुहणार्चं यथा चुतम् ।
 तदहं सम्बवक्षामि साधनम् यथाविधि ॥
 सज्जायश्चोभनाः प्राङ्मा निराकाशा दृढ़ब्रताः ।
 कुलीनाः पापहीनाः साधयन्ति वित्तेन्द्रियाः ॥
 कोटिका वक्तनाकाशं गोमयं सारमिष्वनम् ।
 अमनं लोहपदार्थं धीपर्धं काञ्जिकं विहृतम् ॥
 कन्दरार्थ विचिवार्थ • • •
 सर्वमेसयनं छत्वा ततः कर्म समारभेत् ॥

रक्षोदय उवाच—

साधयित्वा प्रयत्नेन कोटिवेदी महारसः ।
 यरोरेच विनेतेन सर्वं भवति निष्कलम् ॥

नामार्थम् उवाच—

कथयामि न सम्बेदः साकारेन यथा छातम् ॥
 आद्रेत्वस्तु घनत्वस्तु चायर्थं गुहतेजसः ।

यस्तानि न हमले तं विषाहुरत्काम् ॥
 नानायनं भवेत्सूतं विहाय चन्द्रापत्तम् ।
 सच्च इष्टते यस्त्र मूर्च्छितं तं वदन्ति हि ॥
 गुहत्वमहणत्वं वा तेजो भास्त्ररसविभम् ।
 अनिमध्ये यदा तिष्ठेत् शोटवस्त्रं लक्षणम् ॥*

पथातो रसेन्द्रमङ्गलानि यन्त्रविधिः ।

शिलायन्त्रं, पाषाणयन्त्रं, भूषरयन्त्रं, वंशयन्त्रं,
 नस्तिकायन्त्रं, गजदक्षयन्त्रं, दोक्षायन्त्रं, पश्चपातन-
 यन्त्रं, भुवःपातनयन्त्रं, पातनयन्त्रं, नियामकयन्त्रं,
 गमन(?)यन्त्रं, तुलायन्त्रं, कच्छयन्त्रं, चाकीयन्त्रं,
 वास्तकायन्त्रं, अनिसोमयन्त्रं, गन्धकवाहिकयन्त्रं,
 मूढायन्त्रं, हिंडिकायन्त्रं, वाम(?)मालनयन्त्रं चोषा-
 यन्त्रं, गुडाम्बरयन्त्रं, नारायणयन्त्रं, जातिकायन्त्रं,
 चारचयन्त्रम् ।

पथ प्रवक्ष्ये सुगुरुपदेशान्
 वः पाटसाल्लभ रसस्त्र इष्टः ।

* Cf. Resärnava. Vide Sans. Text, Vol. I. pp. 17—18.

यस्य प्रभावात् स्थिरमेहाद्युप्त-
 अवरादिकुहामयनिष्ठः सात् ॥
 निश्चियं सत्त्वे विपुरात्मकम्
 बोक्तं दिशुद्वार्द्धप्रसपमात्मम् ।
 कायेन तत्त्वं विपुरोहवेन
 सम्पर्दयेत् विदिनानि यावत् ॥
 कन्धारसेन विदिनं सत्त्वं
 सप्तार्चिषा चाय टिनवयम् ।
 चूच्छिकाया रजनीरजे न०
 सम्पादितं तम् उपतोयधीतम् ॥
 चौष्णि प्रभाषाम्बुद्धं सप्तमम्
 सम्पातयेत् पातनयम्बयोगात् ।
 सम्पातितो निर्मलतासुपैनि
 नर्वप्रयोज्योऽपि हितं प्रशस्तम् ॥
 पर्ति समादाय रसस्य तत्त्वं
 गुलब्जं शुद्धस्य च कर्षमेकम् ।

* The text seems to be incorrect.

ज्ञात्वा हपिष्ठी विधिवत्तयोर्
 गन्धार्म चूर्णे हिगुच्छ देयम् ॥
 धृतप्रयोगेण विपाच पशान्-
 निश्चिय सुहे परिमादितस् ।
 लिङ्कस् मादां त्वमृतस् दस्ता
 गुणाप्रमाणा गुटिका च कार्यां ॥
 श्रीसोक्लनाथस् विभोः प्रसादात्
 ज्ञातं मया पोटसिकाविधानम् ॥
 • • • • •
 इति रसेन्द्रमङ्गलं समाप्तम् ।

Extracts from RASAHRIDAYA.

भगवद्गोविन्दपादविरचितात्

रसहृदयादुच्चृताः स्मीकाः ।

A = MS. from Nepal.

B = MS. from India Office Library, with a commentary, named "Bālānayabodhikā."

C = MS. from Benares.

हितौयपटलादुच्चृताः स्मीकाः ।

[टीका—मूर्च्छितरसस्य उत्थापनसंख्यारमाह—]

असुना विरेचने हि सुविशुद्धो नागवहृपरिसुनः ।

सूतः^१ पातनयन्ने समुत्तितः^२ काञ्जिके छावात्^३ ।

[टीका—प्रथ मूर्च्छितरसस्य पश्चमोहिष्टपातनसंख्यार्थाहयताह—]

(1) A reads पातन, which makes the sentence incomplete and the metre defective.

(2) A reads सुविशुद्ध, which is a tautology as well as a grammatical error.

(3) काञ्जिके छावात् is the variant in B. This is a defective metre.

सात्वा तु शत्पिणीं निपात्वते नागवह्यहातः ।
 तस्मिन् दोषान् मङ्गां निपतति शह सदा सूतः ॥
 पश्चात्सविस्तारं देवं दशाङ्गलं त्वधोभाष्टम् ।
 कण्ठाद्वः समुच्छितप्रतुरङ्गसक्षमाधारम् ।
 पश्चात्प्रविष्टतस्तमाष्टं वदनजस्तममनिकमस्त्रात्मा ।
 उपरिषाचिपिटपटी० देयोदरवोऽशाङ्गलविश्वासा ॥

- (1) A reads शुष्पिणी.
- (2) निपात्वते नागवह्य सूते is the reading in A, which is incorrect as well as defective metre.
- (3) A reads शुष्प दावांकाङ्गा.
- (4) A reads शह, which is a tautology as well as a grammatical error.
- (5) B reads पश्चात्प्रव विश्वे, which destroys the metre.
- (6) B reads देवं तु, wherein तु is redundant.
- (7) B reads उम वदतुरङ्गसक्षमाधारम्, which mars the metre.
- (8) A reads पश्चात्प्रविष्टपटाष्टं, which is a defective metre.
- (9) B reads शात्मः, which is grammatically incorrect.
- (10) A has उपरिषाचिपिटपटी०, which is senseless.

तस्मिन्द्वौर्भाष्टे^१ निपातितः सकलदोषगिर्ण्यमः^२ ।
 सुतरा भवति रसेन्द्रो जीर्णयासोऽपि पात्कोऽसौ^३ ॥
 क्षत्वाय^४ नष्टपिष्ठं विफलाशिष्ठिश्चराजिकापटुभिः ।
 मंलेष्य चोर्दुभाष्टं दीप्तैरपलैरधः पात्कः^५ ॥
 पथवा दीपकयन्ते^६ निपातितः सकलदोषनिर्मुतः ।
 कस्तुप्रयत्नात्मगंतं^७ मृच्यपीठस्वटीपिकासंज्ञः ।
 यन्मिलिपतति सूतः प्रोत्त^८ तदीपिकायन्तम् ॥

- (1) A reads तस्मिन् रुद्देभाष्टे, which is incorrect.
- (2) निपातितहस्तविन्दुमः, an incomplete variant in A.
- (3) A has an incorrect reading—साक्षीर्दपयावाषी.
- (4) This verse and the next two are not found in B.
- (5) A reads रपैऽप्तमात्रा, which has no sense.
- (6) A has दीपकद्वै.
- (7) A reads क्षत्वपर्वते क्षत्वर्गत, which is grammatically incorrect.
- (8) The word तद् is not found in A, thus making the metre defective.

सप्तमः पट्टाः ।

[टोका—यथ विडविधानमारभते—]

यासं न मुच्छति न वाच्छति तच्च भूयः
कांचिद्गुच्छान्^१ भजति^२ निष्वमनुष्ठमावात्^३ ।
यज्ञीर्यते प्रचुरकेवलवङ्गियोगात्
तस्माहिष्ठैर्मुनिविष्टः सह^४ जारणा स्थात् ॥

[टोका—विडविधानमाह—]

सौवर्च्छलवाट् कवयकाहो^५ कायोसनन्व कौश विष्टः ।
शिष्ठो रसशतभाष्टैस्तामदलाभ्यपि हि जारयति^६ ॥

[टोका—विडान्तरमाह—]

- (1) A reads काचीद्गुच्छान्, which is incorrect.
- (2) B reads वर्षति.
- (3) मुच्छिमुष्ठमावात् is the variant in A,
- (4) A reads मुनिविष्टैरिष्टु, which seems to be incorrect.
मुनिविष्टः means by seven steps, mentioned below.
- (5) A reads उप्ति, which is incorrect.
- (6) A has विष्टरक्षतभाष्टितम् । अस्ति इताभ्यपि हि जारयति,
which is incorrect as well as defective in metre.

सर्वाङ्गदम्भमूलवाप्रतिगतितं सुरभिमूर्त्येष ।

ग्रन्थमाल्यं बन्धिवसया^१ तत्त्वज्ञतो जार्यते देह ।

[टीका—चार चतुर्थगुल्मीवधौराह—]

कठकीपलाशतिस्ति॑निद्वलकानकसुरदालिकासुकैरस्ताः ।

वर्षाभूषणमोक्तकं सहिताः चारा यथाकाभम् ।

[टीका—चारविधानमाह—]

चानीय चारघुणान् कुमुमफलशिफा-

त्वक्प्रसादेष्वपेतान्^२

स्त्रियः मुख्यस्तान्^३ विपुलतरविश्वा-

पिण्डप्राप्तिशुष्कान्^४ ।

(1) एवं अङ्गदम्भमूलवाप्रतिगतिमविवितसुरभिमूर्त्येष, a variant in A, which has no metre at all.

(2) A reads ग्रन्थमाल्यविधानरत्नवदा, which has no sense.

(3) विष is not found in B.

(4) A reads नारीष, which seems to be incorrect.

(5) कुमुमप्रसादशापवडेष्वपेतान् is an incorrect text in A.

(6) A reads त्वक्प्रसादस्तान्, which is incorrect.

(7) A has विपुलतरविश्वापिण्डप्राप्तिशुष्कान्.

दग्धं काञ्जितानां वरिसुरभिहया-

भीमिरामाव्य वर्णोः।

भज्ञ त्वामा अस्ति तत् सृदुशिलिपि पर्वेत्

इंसपाकेन भूयः॥

[टीका—चारणसपाकसंख्यमात्र—]

तस्यमात्रे हि सवासादुदुदान्

यदा विधत्ते च भज्ञरान् वदन्।

तदा चिपेत् चूषणं हिङ्गम्यत्वं

चारणते सप्तवानि भूषणम्॥

(1) A reads वरिसुरभिहयीहामानो च मृते.

(2) A reads ति. which is incorrect.

(3) A reads वायत्.

(4) A reads erroneously वदा वदते.

(5) A reads चिपेत् चूषण. B reads चिपेत् चूषण. Both the readings are incorrect.

(6) A has चारविंशति पट्टवर्षे मूलिक्यं, which mars the metre.

दद्वाचि संमिक्षा निष्ठत्वं भूतसे
 व्यवस्थितान्वस्त्रिकाटोरिकापुटे¹ ।
 संस्थापयेत् लक्ष्मिनानि धार्म्यगं
 ततः प्रयोग्य रमजारकादिकम् ॥

[टोका—जारकायाँ चारविधानमाह—]
 जन्मदीरवीजपूरकं चाहुरोवेतमास्त्रसंयोगात् ।
 क्षारा भवन्ति नितरा गर्भद्विनिजारणे गस्ता² ॥
 [टोका—रसे विष्णुयोजनमाह—]
 विष्णुमधरोत्तरमादो दस्ता सूतस्त्र चाष्टमादेन³ ।
 कुर्यात्वारथमेवं क्रमक्रमादृष्टियेदम्बिम्⁴ ॥

(1) A reads व्यवस्थितान् वस्त्रिकाटोरिकापुटे । B reads व्यवस्थितान्वस्त्रिकाटोरिकापुटे ।

(2) A reads वीजपूरकं, which is incorrect. The word वीजपूर is not found in B.

(3) गर्भद्विनिजारणा गस्ता is an incorrect variant in A.

(4) A has दस्ता शतं चाष्टमादेन, which is not correct as it destroys the metre as well as the sense.

(5) A reads वांशिकि, which is grammatically incorrect.

अष्टमः पटलः ।

[टीका—चतुर रसरागोऽभिधासते—

अभ्यक्तजौर्यस्य लायाविशेषमाह—]

बीर्द्धन्मको^१ रसेन्द्रो

टर्ययति^२ चनानुकम्पिनीं लायाम्^३ ।

लालां रसां पौत्रां

सितां^४ तथा सहरं मित्राम्^५ ।

(1) A reads बीर्द्धन्मक, which mares the metre.

(2) A reads टर्ययति, which is incorrect.

(3) चनानुकम्पिनी लाया is the variant in A. चनानुकप्तं-
लाया is the variant in B. Both the readings seem to be
incorrect.

(4) लाल रसां पौत्रं लित is the reading in A, which is
incorrect.

(5) A reads ददा उचरीचिंचाः, which is incorrect.

[टोका—पञ्चवायोगाहचंद्रिष्ठेषमाह—]

ज्ञात्त्वाच्चकेच बलवत्^१ सितरागेऽन्यते^२ रसेन्द्रसु ।
यते रसैः पीतैः वज्रैः सहू वचतो चेयः^३ ॥

[टोका—पञ्चरसप्रश्नसामाह—]

पञ्च निश्चमेव हि वचैः

न जहाति यदा स रञ्जते^४ रागैः ।

क्रमयो हि भज्यमाणो

निर्विज्ञो^५ रसं तु दत्तं ॥

(1) चैतावदेव वचान् is the variant in A, which is incorrect.

(2) A reads वितरावैः पूर्वते.

(3) A has नविज्ञो चेय, which has no clear sense.
B has विवर्चतो चेयः, which marks the metre.

(4) B reads वच निश्चमेवत्त, which is not correct.

(5) A reads वच रसशीयते, which is grammatically incorrect.

(6) A reads भज्यमाणा, which is incorrect. B reads क्रमयो भज्यमाणो, which is also incorrect.

(7) A reads नारकी.

[टीका—अभस्त्वादोना योगे रसे अवश्यमाह—]
बलनासोन्नकससे बारचरागः प्रतिष्ठितास्तीक्ष्णे^१ ।
बन्धस सारसोहु^२ सारचमद्य^३ नागचक्राभ्याम्^४ ॥

[टीका—सर्वकरणं तीक्ष्णमाह—]
क्रामति तीक्ष्णेन रसः तीक्ष्णेन^५ जीर्खते चचाङ्गुष्ठः^६ ।
हेचो योनिस्तीक्ष्णं रागान् एक्षाति तीक्ष्णेन ।
[टीका—तीक्ष्णहिङ्कूलयोगेन शुचाधिकरमाह—]
तदपि च दरदेन हते इत्वा माचीकेण रविष्टहितम्^७ ।
वासितमपि वासनया घनवशार्थं जार्थं ॥

- (1) A reads erroneously निष्ठिता तीक्ष्णा.
- (2) A reads बारचराहै:, which is incorrect.
- (3) A reads बालचमद.
- (4) B reads नागचक्रमः;
- (5) A reads तीक्ष्णे च.
- (6) A reads वासि, which is incorrect
- (7) A reads जीर्खस्तीक्ष्णे, which has a defective metre
- (8) B has omitted इत्वा माचीकेण रवि.

[टौका—तौल्यवदेनामाह—]

कालं वा तौल्यं वा काङ्क्षीं वा वज्रसुखक वापि^१ ।

एकातमं सर्वं वा रसरजने सहरोऽभीष्टः^२ ।

[टौका—स्ते स्ते विकारि वस्त्रमालमाह—]

कुटिले^३ वस्त्रमव्यधिकं रागसौच्ये तु पश्चगी खेदः^४ ।

रागखेदवनानि तु कमसे शंसन्ति धातुविदः^५ ।

सर्वेरभिसौर्ईर्याचिक्कसहितैर्मतिस्त्रादा गम्भे^६ ।

विद्ययोगेन तु जीर्णो रसराजो विद्यति लोहेषु^७ ।

[टौका—रसवस्थानां मारवे विधानमाह—]

मालकं दरदशिसामिः खेदचाराम्बसवचसहितामिः ।

(1) काङ्क्षीं वा वज्रसुखकादीना, a variant in B.

(2) रसिपि हि रसायने विद्यात्, a variant in A.

(3) This is not found in B.

(4) A reads erroneously पश्चवेद्.

(5) A reads शामुविदं, which is incorrect.

(6) This sloka is not found in B.

(7) A reads मारवे.

समकाहिगुच्चिगुचान् पुटो वहेद्वश्चादीन् ॥

[टौका—मुट्ठतधातुखत्यमाइ—]

रक्षेहनिथेकैः सेकं कुर्याद्रसस्य पिटिरियम् ।

चारणजारणमाचात् कुहते रसमिन्द्रगोपनिभम् ।

[टौका—सुख्यत्वेन ताम्बप्रदंसनमाइ—]

अथवा^१ केवलममलं कामलं दरदेन वापितं कुहते ।

दिगुचं ओर्चे ओर्चे जाचारसमविभं सूतम् ।

[टौका—विष्वन्तरमाइ—]

रक्षगणगक्षितपशुजल-

वहु^२भावितताप्यगन्धकगिसानाम् ।

(1) विवाहवैषः च आदीन्, a variant in A, which has a defective metre.

(2) B reads वहु.

(3) A reads वहेद्व, which is incorrect.

(4) B reads erroneously वह.

(5) वहेद्व हि ओर्चंओर्चे, a variant in B.

(6) The word वहु is omitted in B, which renders the metre defective.

(7) A reads वहेद्वश्चादीनः.

एकेन वापितमृतं'

कमलं रस्य यति रसराजम् ।

[टौका—रागाधिकारि-गम्भकादीनाह—]

वाञ्छो गम्भकरागो³ विलुक्तिरागे⁴ मनःयित्तात्तासे ।

माचौक 'मस्वरमवो द्वावेतौ' रस्यने शस्त्रो ।

[टौका—प्रधानयोः तान्नस्वर्परयोः लक्ष्माह—]

क्षमहृष्टैः रविरमवेः⁵ मंशुहो मूकमूर्धिकाध्यातः⁶ ।

(1) A reads वापितमृतं, which seems to be incorrect.

(2) A reads वंभकराग, which is incorrect.

(3) A reads वित्तरागी. B reads विलुक्तिरागेष. Both the readings are grammatically incorrect.

(4) B reads नाचिष, which mars the metre.

(5) B reads द्वावे फि, which seems to be incorrect;

(6) A reads लक्ष्महृष्टैरविरमिष्टैः. B reads लक्ष्महृष्टै रविरमवो.

We have adopted the above reading after collating the texts.

(7) मूर्धिचासुरिचातः, a variant in A, which mars the metre. मूर्धमूर्धिकाध्याती, a variant in B.

विगुर्व लीचों जीचों हेमाभो जायते सूतः ।

[टीका—पञ्चकयोगमाइ—]

पथं लक्ष्याभक्त्युचं पुटितं रसं भवेत्तदा शक्तम् ।

विगुर्व लीचों जीचों हेमद्रुतिसंनिभः सूतः ।

[टीका—स्वर्वमारणमाइ—]

विगुणेन मालिकेन तु कलकं च सूतं रसतालयुतम् ।

पटुसहितं तत् पक्षं इच्छकाया यावदिन्द्रगोपनिमम् ।

(1) A reads लीचे जीचे. B reads लीची लीची.

(2) A reads इतिहृतिभी बरेन्, (इति—हृत). B reads हिमवत्ती आहते, which mars the metre.

(3) A reads चक्षा, which destroys the metre.

(4) A omits तत्.

(5) A reads लीचे लीचे, which seems to be incorrect.
B reads लीची लीची.

(6) हेमद्रुत(?)भिन्नी भरेन् ततः, a variant in A.

(7) कलकं रसतालयुतम्, a variant in A, which is a defective metre. The reading of B, which we have adopted, is also a defective metre. The word तत् or तात् should be added after the word युतम्.

[टीका—एतद्वाजौर्चस्तव सर्वमाह—]

तस्युचं स्तवरे द्विगुचं जीवं हि जीर्चं तु ।

हुतेमनिभः स्तोऽ रथ्यति लोहानि सर्वाच्चिः ।

[टीका—सर्वेषां धातुनां रसानामुत्तरोत्तरविशेषत्वमाह—]

पशादद्वयुचं सत्त्वं सत्त्वादद्वयुचं हुतिः ।

हुतेरद्वयुचं दीवं तज्जाद्वीजं तु आरयेत् ।

(1) A reads जीर्चं तु. B reads जीर्चे हि.

(2) एतेमनिवर्ती, a variant in A, which seems to be incorrect.

(3) A has अरति लोहानि रसानि. B has इरवति लोहानि रसानि. Both the readings have defective metre.

(4) This verse is found in A after the verse तारज दरद्विभासिः &c, (vide ante pp 28—29) and runs thus :—

पशादद्वयुचं दम्भा तज्जादद्वयुचं हुतिः ।

हुतेरद्वयुचं दीवं तज्जाद्वीजं तु आरयेत् ।

नवमः पट्टसः ।

[टीका—बोलप्रश्नसनमाह—]

इति रसोपि रसेन्द्रो बोलेन विना न कर्माणादुभवति ।

हिविधं तत् पौत्रसितं¹ नियुज्यतं सिद्धयेच रसम्² ॥

[टीका—रसोपरसधातूनां बहुविधत्वात् शोषन-
माह—]

तस्य विशुद्धिव्युधाऽगग्नरसोपरससोह्यत्पैद्य ।

हिविधं वौजं तेरपि नायुज्येः युधते कदाचिदपि³ ॥

[टीका—पशुव्योलप्रभातमाह—]

यः पुनरितेः कुरुते कर्माण्डैभैवेदससाक्ष ।

(1) B reads धीतं हितं which destroys the metre.

(2) नियुधये चिद्धयेच रक्ष, an incorrect variant in A. नियुधते चिद्धयेच रक्ष, a variant in B. Both texts are collated in our adopted reading.

(3) रसति हिताचा, a variant in A, wherein the first term seems to be incorrect.

(4) B reads नैतत् instead of कदाचिदपि. This is incorrect; since it contains two negatives.

पश्चापकः पतङ्गोऽ न रसे न रसायने योग्यः ।

[टीका—रससंचकानाह—]

वैक्रान्तकान्तसंचकमाचिकविमलाद्विदरद-
रसकाह ।

पष्टो रसास्तयेषां सखानि॑ रसायनानि॒ सुः ।

[टीका—उपरसंचकानाह—]

गत्यकगैरिकसुयित्ता॑ चितिष्ठेचरमस्तन्त्र
कहुङ्गम् ।

उपरसंचमिट्टात् शिलिघिनो सारलोहास्यो ।

- (1) चक्रापकपतंयि, a variant in A, which is incorrect.
- (2) A reads योग्ये. B reads रसापकयने योग्यः. Both the readings are incorrect.
- (3) A omits कान,
- (4) A reads माचीक, which mars the metre.
- (5) A reads द्विदरसकेण.
- (6) A reads वलीर, which is not accurate.
- (7) B reads द्विकालक, which destroys the metre.
- (8) B reads द्विकालिद, which mars the metre.

[टोका—पूतिसंज्ञके आइ—]

ताम्बारतोच्छशान्ताभ्रवज्जोहानि¹ नागवङ्गो च² ।

कवितो च पूतिसंज्ञौ³ तेषां संशोधनं कार्यम् ।

[टोका—सवष्वारसंज्ञे आइ—]

सौवर्णसंसेन्धवकं चुनिकमामुद्रोमविद्वानि ।

षड्लवष्वान्वेतानि तु सर्वादिवटहसाः जाराः ॥⁴

[टोका—शोधकद्रावकगयमाइ—]

दद्विवत्तेः कदम्बी कन्धा⁵ कोशातकी च सुरदासी ।

शोधुयः वज्रकन्दो नौरवचा वाहमासी च ।

चासामेकरसेन तु लश्वष्वारामनाविता वहयः ।

शुद्धनि रसोपरसा आता सुचन्ति सत्त्वानि ॥⁶

(1) B reads उत्तरोहानि.

(2) B reads वहनावी च.

(3) B reads कवितो चुम्बवंज्ञौ, which is incorrect.

(4) This verse is not found in A.

(5) A reads शुक्वादर्त्तक.

(6) B reads वहया.

(7) A reads विद्वय.

(8) This verse is found in A only.

[टीका—शोधकाद्रावकाचां शोधनद्रावकविधान-
माह—]

स्त्रियः सचाराक्षेः^१ भातं वैक्षामतकं हठाहृष्टि^२ ।
तद् दृतमात्र^३ शुद्धति कामं शशरसभावनया ।

[टीका—तत्त्वाह—]

मस्तकमपि रसगच्छेः^४ कुमावित सेहरागसंसुक्तम्^५ ।
शुद्धति वारेः^६ सप्तभिरतः परं दुष्यते काष्ठेः^७ ।

[टीका—तत्त्वाह—]

चारैः सेहरादो पशादाक्षेन^८ भावितं विमलम् ।

(1) A reads सचाराक्षं.

(2) A reads हठाहृष्टि, which is incorrect.

(3) A reads तद्दृतमात्रे, which is incorrect.

(4) B reads रसगच्छेः, which seems to be incorrect.

(5) भावितः सेहरावर्णितः, a variant in A.

(6) A reads रारेः.

(7) क्षमितः परं शोषयेत् काष्ठेः, a variant in A, which mars the metre. B reads क्षमितिः परं, wherein क्षमितः is incorrect as well as a defective metre.

(8) B reads पशात् उखेन.

शुद्धति तथा च रसकं दरदं मात्रौकमयेषम् । ।

[टीका—ताम्बूधनमाह—]

तनुरविपत्रं सिसः लवण्यारात्रविष्णुक्षीरे^३ ।

आतं निर्गुण्डोरससिङ्गं वहूग्नो वहेदृष्टवत्तच^४ ॥

[टीका—लोहयोधनमाह—]

शुद्धति नागो वहूग्नो घोषो रविषा च वारमुनिसंख्यः^५ ।

निर्गुण्डोरससिकै^६ सात्यसरजः प्रदायेत् ।

[टीका—तथाह—]

(1) दरदमाचिकमयेऽ तथा शुद्धति, a variant in A, where-in the last two words are superfluous and incorrect.

(2) B reads तनुरपि पवस्तिः, which has no sense.

(3) A reads वुहि. B reads वुषा. Both the readings destroy the metre.

(4) A reads वहूग्नी वहेदृग्ं. B reads वहूग्नी दृष्टवत्त. Both the readings are defective.

(5) घोषो रविरोधमयि च मुनिसंख्यः, a variant in A. B reads रविषा च वारमुनिभिः. Both the readings are incorrect.

(6) B reads फिङ्ग, which is not correct.

रसगणसितपश्चलभावितपुटितं च रच्यते^१ तीर्तम् ।

शुद्धति कदम्बोद्यस्त्रिरसभावितपुटितं^२ विभिर्वादः ।

[टीका—मारणमाह—]

सर्वः शुद्धति लोहो रच्यते^३ सुरगोपसविभो वाणात् ।
मार्जिकासत्वे सूक्ष्मं शुद्धं वा गन्धकेन इतम्^४ ।

एकादशः पठतः ।

कागास्त्रिभक्तनिर्दितनूजां काल्वैवामलकाकारां ।
दसयोगे घनरम्भां टंकचिष्ठगुच्छातसेपां ॥

- (1) A reads रचते, which is incorrect.
- (2) शुद्धति कदम्बोद्यस्त्रिरसभावितपुटितं, an incorrect variant in B.
- (3) A and B read रचति, which is grammatically incorrect.
- (4) A reads शुद्धति. B reads शुद्धते भ. Both are unintelligible.
- (5) A reads शुद्धते वा वंशकैव चतु. B reads शुद्धते.

[टीका—अथ स्त्रियारथितुर्वशवर्णमाह—]

योतांशुर्वंगसच्चवैहयकुसज्ज्ञनितकुलं महिमा ।

अयति श्रीमदनरथः किरातनाथो रसाचार्यः ॥

[टीका—अथ चास्य कारथितुर्वशवर्णमाह—]

यस्य स्त्रियमवतीर्णा रसविद्या सकलमहस्तावारा ।

परमन्त्रेयसहेतुः श्रेयसि परमेष्ठिनः पूर्वंम् ॥

येन चतुर्वर्णस्त्रे चादिव्याधादिक्षमस्त्वामम् ।

दक्षिणरसा यहीता चादिवराहेष्व महाप्रस्तुये ॥

(1) शुर्व is not found in B.

(2) स अहति श्रीमदनरथ, a variant in B.

(3) C reads दक्षिणमहस्तावारा.

(4) Of the latter half C has only एव उहितुः.

(5) C reads चतुर्वर्णस्त्रे चादिव्याधातपस्त्रमहस्तामम्, which seems to be incorrect. Cf. Patala I., in which the following verse is given :—किरातमीणादिवातापस्त्रादिव्यमेष्वराक्षमकुशकात्याख्ये । दिव्यलि वामाविषमेष्वज्ञात्या इत्याचरणाङ्गतिमामवातीः ॥

(6) दक्षिणम्भुरुष यहीता is the incorrect reading in C.

[In the case of किरातनाथ रसा: यहीता; i. e. collected रस—mercury, minerals &c. and इत्येष्व is favorable; and in the case of चादिवराह रसा यहीता i. e. lifted up the earth.]

(7) This verse and the next are not found in B.

नष्टग्रीवविवर्ता हौनाह्नः कुहिनो गुणादयस्त् ।

चमिनवसोमेश्वरतामापुरपि पुनर्नवेरहूः ॥

[टोका—कार्त्ता स्त्रनाममहस्तं सूखयत्वाह—]

तस्यात् क्षिरातन्तृपतेः बहुमानमवाप्य रसहकर्मरतः¹ ।

रसहृदयास्यं तत्क्षेत्रं विरचितवान् मिहुगोविन्दः² ॥

मसा महूलविष्णोः सुमनोविष्णोः सुतेन तत्क्षोयम्³ ।

श्रीगोविन्देन लातः⁴ तथागतः श्रेयसे भूयात् ॥

पष्टादशसंस्तारं रसेन्द्रदेवस्त् दिव्यातनु हृष्टा ।

क्षिञ्चित्तमिदं पुख्यतमं रसहृदयमवाप्यते सखात् ॥

(1) C reads रसहृदौपदेशती हृष्टा, which destroys the metre.

(2) C reads रसहृदवेष्टत, which seems to be incorrect.

(3) C reads विरचितवान् मवदहनीविन्दः, which is incorrect.

(4) C has रकाटव्यनाम तत्क्षोयम्, which is incorrect.

(5) C has श्रीनदमवदहोविन्देन लातः, which mars the metre.

(6) This verse and the next are not found in B.

इति श्रीमद्भगवद्गोविन्दविरचितं
रसायनदर्शनं समाप्तम् ।
शुभसन्तु ।

संवत् १५०४ समये व्येष्ठ वटि ११ भौमि
जगद्वायमह सेष्ठ ॥

श्रीराम इस संवत् १८८० पौष वटि १ भौमि ।

(1) MS. A ends abruptly with the colophon, which runs thus :—इति श्रीमोविन्दधरवक्तुपादविरचिते रसायने श्रीराम-
विविकार एवविवितितः पट चः ॥ The author's account
of himself is altogether wanting in it. B has "इति यज्ञ-
रुपेष्टकुरुक्षिरोठनुवादनावास्त्वपादप्रसादवक्तुविद्यापारोप श्रीमद्विन्द-
मीविन्दक्षती रसायनः लक्षणः । इति श्रीमद्बुरद्वयंवरदीपितुषाकृ-
विन्दमहेश्वरामवशीचनुर्जुब्दविरचितात् ॥ उच्चे वाचा-
वद्वायिकाक्षायां रसायनठोकादा रहःरङ्गामक एकीविन्दीपवीतः ।
इति श्रीः ॥

Extracts from KAKACHANDESVARIMATA.

काकाचरणेश्वरीमत्तम्भात्

समृद्धाः द्वोकाः ।

ॐ नमः सदाशिवाय ।

कैकासश्चरामौनमुमा रहं जगदगुरम् ।
 कांदनंदीमहाकालौ भूंगचक्रीविनायकौ ॥ १ ॥
 योगिनौनामष्ट तव गुब्बादगुब्बतरं परम् ।
 कपाली कालरात्रो च कालचंद्रकलाम्बिका' ॥ २ ॥
 कराली कालकर्णी च काकचक्रेश्वरी तथा ।
 एवमादिस्त्रया चात्या योगिनौयजगुब्बकैः ॥ ३ ॥

(1) The text reads कालचंद्रकलाम्बिका, which is incorrect.

(2) The text reads गुब्बदो, which is incorrect.

नृत्यवाद्य सुखेशानैः सानन्देर्हृष्टेतसैः ।
 तत्स्य भैरवं देवं योगिनीगणवेष्टितम् ॥ ४ ॥
 केचित् स्तुवन्ति संहृष्टाः केचिच्छ्रावयन्ति गुद्धकाः ।
 केचिच्छ्रूत्यन्ति गुद्धा यि केचिद्वाद्यं न कुर्वते ॥ ५ ॥
 हृषिणः^१ भैरवं देवं पञ्चवङ्गं विलोचनम् ।
 तं हृष्टा भैरवी हृष्टा अगतां विदशेषरी ॥ ६ ॥
 लक्षणसिपुटा भूत्या लक्षणतारकसोचना ।
 काकचक्षेष्टरी देवी उवाचेष्टं तु भैरवी ॥ ७ ॥

काकचक्षेष्टरी उवाच ।

भगवत् देवदेवेश सर्वज्ञ सर्वविच्छिन्न ।
 सर्वज्ञानप्रकाशाय घडं पृच्छामि शंकर ॥ ८ ॥
 कायं कायस्थितो जीवो जीवकोऽसौ प्रकोस्तिनः ।
 कायस्थः कर्मणा केन स्थितः संसारयंजरे ॥ ९ ॥
 वराव्याधिदारिद्रेष पस्तः संसारवैवनेः ।
 एको व्रजति यानेन एकः स्कंधे वहेत्त तम् ॥ १० ॥

(1) The text reads हृष्टं, which is not correct.

(2) The text reads सर्वच्छिन्नः, which is not correct.

जयजयगच्छं मांगस्यमिकस्याने च ऊंतवः ।
 किं कुर्वाणा: प्रकुर्वाणाः कस्यामे ग्रूहि शंकर ॥ ११ ॥

श्रीसर्वज्ञ उवाच ।

गृह्ण त्वं काकचामुद्दे साधकानां हितं प्रिये ।
 गुणादगुणातरं पापं पृष्ठोऽहं तु वरानने ॥ १२ ॥

कथयामि समामेन शृणु त्वं काकचांडके ।
 यस्याधंशं परो नित्यः प्रमादिनिधनेश्वरः ॥ १३ ॥

सुरूपो निर्गुणः शांतो विश्वास्यापौ परात्परः ।
 प्रमादिकमंसंबंधः कायस्तो भवते तु सः ॥ १४ ॥

जौवे व्याधिमयं कर्म पञ्चानात् संप्रकौर्सितम् ।
 तत्कात् कर्मभवात् क्रिष्टः संसारे संसरेत् सः ॥ १५ ॥

करोति विविधं कर्म संसारे कामभोहितः ।
 द्रव्योपायं न जानाति कामभोगार्थेतुना ॥ १६ ॥

कायं क्लेशेन मानव्यो द्रव्योपायं करोति सः ।
 त्रिपितामित्यसेवायां मेषाविक्रयविक्रये ॥ १७ ॥

- (1) The text reads काकचांडे, which is incorrect.
- (2) The text reads करोतु, which is not accurate.
- (3) The text reads काकचांडेन, which is not correct.

वहन्ति काष्ठभारां दृष्टभारमनेकधा ।
 यानं यवनश्चत्र⁽¹⁾ च किं करोति⁽²⁾ करोति सः ॥१८॥
 कामासल्लग्नः श्रीमान् कुरुते कर्म नेकधा⁽³⁾ ।
 कुर्वाण्याश नराः केचित् कामासल्लार्थचित्तकाः ॥१९॥
 आयंते मत्खंकोक्तिभिन् दारिद्रोपहतचेतसः ।
 आयंते नाच संदेहो कुमखंजा नयुंसकाः ॥२०॥
 महासंसारबंधेन विगुणेन सुयंचिताः ।
 अटव्यां घोरसंघट्याटिकां तु नयन्ति तत् ॥२१॥
 एतसे कथितं भद्रे यस्य मा परिपूर्जसि ।
 किमव्यत् पृच्छमे भद्रे तथा ते कथयाम्यहम् ॥२२॥
 इति काकचंडेश्वरौमते प्रथमः पटसः ।

श्रीकाकचण्डौ उवाच ।

कथयत्वा महादेव कामभीगप्रसाधनः ।
 अर्थः संप्रयते यैन चक्रेश्वरं परमेश्वर ॥१॥

(1) The text reads वृष्टश्चत्र, which is incorrect.

(2) The text reads फि कुर्वति, which is incorrect.

(3) The text reads कुरु कर्मनेकधा, which is incorrect.

तटहं त्रोतुमिष्वामि कथयस्थ प्रसादतः ।
 आकाशगमनं देव खेचरस्वं यथा भवेत् ॥ २ ॥
 पाटुकाया दन्ते पञ्चदिव्यस्त्रौकामसाधनम् ।
 रोक्षनं पंजनं चैव धातुवादरसायनम् ॥ ३ ॥
 जनूकावंधमित्याहुः रसस्य मारणं कथम् ।
 जारणं रक्तकस्तृत्वं वज्रिभद्रावणं कथम् ॥ ४ ॥
 एतत् सर्वं समासेन द्रौहि मे विपुरांतक ।

श्रौभैरव उवाच ।

शृङ्ग त्वं काकचाढुडे साधकानां हितं प्रियं ॥ ५ ॥
 कथयामि समासेन पृथक् मिहार्दसाधनम् ।
 न द्रव्येष विना मिहिनं भोगाः काम एव च ॥ ६ ॥
 द्रव्यहीना नरा मत्त्वे प्रेतरूपेण संस्थिताः ।
 अटंति मत्यंलोकेच्छिन् पर्युपद्रवकारणम् ॥ ७ ॥
 • • • विवं (?) तेषां जायतोषि भृतश्रुतेः ।
 कुलं सौभाष्मस्त्रं च पांडित्यं ज्ञानसंस्थितम् ॥ ८ ॥
 द्रव्यहीना न शोभते प्राणहीना नरा यथा ।
 कुसितो ज्ञानहीनोषि केनापि वधिराः स्थिताः ॥ ९ ॥

पश्यते मर्त्यनोकेजिन् द्रव्यसं मवारधजम् ।
 तथात् संसाधयेहेवि रसेन्द्रं साधकोत्तमः ॥ १० ॥
 अथातः संग्रहचामि रसेन्द्रसाधनं तद् ।
 मारणं जारणाद्यं च द्रव्यमाधनमुत्तमम् ॥ ११ ॥
 वज्रदंडः सुदंडव लोहदंडसाधेव च ।
 वयो विना ओषधये रसस्य मारणे हिताः ॥ १२ ॥
 तात्रि दोध समाप्तेन यदा जानति साधकाः ।
 वज्रदंडसु वर्णो खात् लोहदंडं पुटं विहः ॥ १३ ॥
 सुदंडं वज्रदंडं च समाप्तात् कोर्त्तिं तद् ।
 याहयेत्सं समाप्तेन साधकाः इष्टमानसः ॥ १४ ॥
 तदसं रससंयुक्तं एकोलत्वं तु मर्दयेत् ।
 अंधमूषागतं आतं रसं नियित तत्त्वात् ॥ १५ ॥
 महस्त्रवेष्टी कर्त्ता च ज्ञायते स महारसः ।
 भूयां संसेपयेत् तेन पुराएष्ट महोपष्टीः ॥ १६ ॥
 अंधयित्वाग्निमध्ये तु रतिदंधः पथं विघ्नः ।
 पश्यात् पलसद्द्वैकं शुद्धत्वं याहयेद्वुधः ॥ १७ ॥
 अस्त्रवर्गं हतं शुद्धत्वं चारवर्गं हतं शुभम् ।
 वज्रीचीराक्षीरेण मर्दयेत् शतधा नरः ॥ १८ ॥

पुरं दध्यात् सप्ताहेन कालिकारहिते भवेत् ।
 मूणगमोदरे चिता आमयेत् छुदिरानस्तेः ॥ १८ ॥
 रसेन्द्रः चित्यते तच तारं उंकायते चकात् ।
 चयातः संप्रवक्षामि शूष्याबंधं यथा भवेत् ॥ २० ॥
 शुस्तिकाः चाहयेत् प्राङ्गन्तु च पापाच्च वर्जिताः ।
 तुषादन्ताजयो याज्ञा सद्भागात् चयस्तावा ॥ २१ ॥
 एकोजात्य तु संयंचि मूष्यां तत् कारयेद्दुधः ।
 गोकर्णाकारसहगोमवामस्तवं कुरु ॥ २२ ॥
 शूष्याबंधमिति श्वातं साधकानां द्विताय वै ।
 चयाच्चात् संप्रवक्षामि रसस्य मारणं यथा ॥ २३ ॥
 चाहयेत् पूर्वदद्युयः चोपचौरिस्तसः साधकः ।
 मूष्यां संलेपयेत् तेन धात्य कर्म समाचरेत् ॥ २४ ॥
 रसेन्द्रो चित्यते चितं कुरु कर्म यदिच्छया ।
 वोतोदकेन कासेन इमकर्माणि वा त्रुटु ॥ २५ ॥
 कारयेत्तोहमयं पार्वं तप्तोऽु रुक्षयं शुभे ।
 प्रत्योक्षपुठरं लक्ष्मं कारयेत् साधकोपासमः ॥ २६ ॥
 प्रधोयन्ते तं धात्य चायस्तं तद जारयेत् ।
 असप्तस्तोदरे हृष्टं अरते नाश संययः ॥ २७ ॥

तदृगुणं आयसं तच्च हेमं चाष्टगुणं ददेत् ।
 चौरवज्रं तथा चारो षट्ज्ञारो उदिरयतो । (?)
 पाहयित्वा रसं तेषां आयसं जारयेत्तरः । २८ ॥
 हेमं संजायते तच्च धर्म्मकामायेसाधनं ।
 एष्ट खल्लोदरे तद्दे हेमं वडमुखतां भवेत् । २९ ॥
 पुरा महोषधैर्युप्तं जरते नात्र संशयः ।
 जारिते सारितं दद्यात् पुनस्तं जारयेद्याद् । ३० ॥
 कुरुते कर्मसंघातं कर्मं सिद्धयेसाधनं । ३१ ॥
 जारणं मारणं चेव समाप्तात् कौत्सितं मया ।
 किमन्यत् पृच्छसे भद्रे तथा ते कषयाम्यहम् । ३२ ॥

इति श्रोकाकर्णलेखरोमते हितोयः पठसः ।
 पथाम्यं संप्रवक्षामि अभ्यक्षम् यथाक्षमम् । २० ॥
 द्रावणं अभ्यक्षसेव समाप्तेन विधीयते ।
 चौरकांचुकिचुच्चेन तद्वसेनाभिमाणितं । २१ ॥
 निर्गुच्छोवजजटस्तु तद्वसे भावितं कुरु ।
 एकैकां सप्तवारेषु भावयेत् साधकोत्तमः । २२ ॥
 (भावनात्मे) अभ्यक्षम् पम्बे चिपेहिनवयं ।
 हृष्टत्वा सप्तरात्मं तु चिपेदभ्यं नरोत्तमः । २३ ॥

—
॥२८॥ गुरुवार्षिकी द्वारा
• • • • • श्रीमद्भगवत्
॥२९॥ जयन्त्री वर्षात् विश्वामी
॥३०॥ लक्ष्मी विष्णुवान् द्वारा द्वारा
॥३१॥ व्यज्ञनात् विश्वामी
॥३२॥ इस वर्ष सभी विश्वामी
॥३३॥ विश्वामी विश्वामी
॥३४॥ विश्वामी द्वारा द्वारा
॥३५॥ द्वारा द्वारा द्वारा
॥३६॥ विश्वामी विश्वामी विश्वामी
॥३७॥ द्वारा द्वारा द्वारा द्वारा
॥३८॥ द्वारा द्वारा द्वारा द्वारा
॥३९॥ द्वारा द्वारा द्वारा द्वारा

Extracts from RASENDRACHUDAMANI.

सोमदेवविरचितात् रसेन्द्रचूडामणे:
उदृताः स्तोकाः ।

रुप्येण सङ्क संयुक्तं आतं रुप्येण चेष्टगीत् ।
तदा निश्चयमित्युक्तं लोहं तदपुनर्भवम् ॥
एवं रुप्यं समागं चेत् आतं ताम्बं लगीवहि ॥

निष्कमावे तु नारीऽस्मिन् लोहखार्यां इति सति ।
म्बतो लक्ष्युयां हैर्मी गलाकां यमति भ्रवम् ॥
कुसुधतैलतसं तत् ऋष्यमुहिर्गति भ्रवम् ।
गुणानागोऽयस्मुहिष्ठो वस्ति लक्ष्यमैरवः ॥

- (1) The text reads उच्च. But रसरबसमुच्चय reads उच्चेन, which seems to be correct.
- (2) The text reads उच्चे मुहिरि, which is incorrect.
- (3) The text reads मुहिदर्शिति, which has no sense.

तीर्थं नीकास्त्रनोपेतं धातं हि वहुयो ददम् ।
 मदुक्षाण्डं द्रुतद्रावै वरमागं तदुच्चर्ते ॥
 मृतस्य पुनरङ्गुतिः संप्रोक्तोत्यापनास्ययः ।
 द्रुतद्रव्यस्य निष्टेपो द्रवे तद्वालनं मतम् ॥
 चिंशत्पक्षमित नागं भानुदुर्घेन महितम् ।
 विमर्हं पुटथीत्तावत् यावत् कर्णविश्वेष्यितम् ॥
 न तत् पुटसहस्रेण चयमायाति रक्ष्यथा ॥
 चपलोऽयं समुहिष्ठो वाक्फिकैर्नागसुभवः ॥
 इत्यं हि चपलः कार्यो वहुस्त्रापि न संशयः ।
 तद्वाटडक्कसंसृष्टः केवलो बधते रसः ॥

(1) The text has द्रुतद्रावै, which is incorrect. We have adopted the text of रहस्यमुख्य.

(2) The text reads शारीरकादनाकाव, which seems to be erroneous.

(3) The text has चयमायाति रक्ष्यथा, which is grammatically incorrect.

(4) The text reads नारीहुमः, which is incorrect.

(5) The text reads इत्यं चौरपल, which is senseless.

स रसो धातुवादेव ग्रस्तं न रसायने ।
 अयं हि सुर्यकाश्येनः लोकनायेन कोर्त्तिः ॥
 भास्मकाल्यरजः सूखं पश्चमांश्चरसान्वितम् ।
 कुमारौमूलतोयेन महेयद्यवासरम् ॥
 चाह्नरौस्वरसेनापि दिनसेकमनारतम् ।
 एवं भूमागच्छातेन महेयेहिवसद्यम् ॥
 अथेकपञ्चमानेन तावता व्रष्ट्यापि च ।
 दशनिष्ठरसेन्द्रेष द्रस्त्वपिष्ठौ समाचरित् ॥
 योजयित्वाथ कल्केन यथापुञ्चं विमहेयित् ॥
 ततः साररसेन्द्रेष सत्त्वेन रसकम्बुच ।
 पिष्ठौ जात्वा तु पूर्वेण पूर्वकल्केन योजयित् ॥
 अथ प्रचार्ष्व कोर्त्तेन⁴ काञ्जिकेन प्रशोषयित् ।

- (1) The text has रसायनम्.
- (2) उर्द्धकारोन is the reading in रसरबसमुहृष.
- (3) The text reads दिनसेकमनारतम्, which has no clear sense.
- (4) The text reads शोरेन, which is unintelligible.

यस्ताईशुद्धसखेन भृष्टगुणारसेन च ।
 विमहं रकाच्छिके कुर्यात् मरिचप्रमितां गुटीम् ॥
 निरध्य वज्रमूषायां सम्बिदन्वं विधाय च ।
 शुषिरेनवभिः² सम्यग्भस्त्राभ्यां च धमेत् खलु ॥
 ततो मूषागतं सत्त्वं उमादाय समन्वतः ।
 धमेत् प्रकटमूषायां वहनालेन शुद्धये ॥
 दशशारं हि तत्सत्त्वं भस्त्रना नवयेन च ।
 सकाच्छिकेन संवेद्य पुटयोगेन शोघयेत् ॥
 हिनिष्कप्रमिते तस्मिन् पूर्वप्रोत्तेन भस्त्रना ।
 अशीतिगुणितं नागं भात्वा निर्वाहयेत् खलु ॥
 इयता³ पूर्वसूतोऽसौ जीयते न कथच्छन ।
 उपसूतोऽयं ममुहिष्ठो लोकनाथेन शश्मुगा ॥
 अमेनापि रसः शोघुं बधते पूर्ववत् खलु ॥
 कारवङ्गीकटाकृकृटश्चापुष्टिनो हि सः ।
 भवेत्तागविनिर्वासो यासं गृह्णात्वाशेषतः ॥

- (1) The text reads मरिचप्रमिता गुटी, which is incorrect.
- (2) The text reads शुषिरेनवभिः, which has no sense.
- (3) The text reads इयता, which is incorrect.

सुखं प्रकटमूष्यायां भवेत् विगुणोत्तरम् ।
 जीर्णयामो रमोऽप्नेष देहलोहकरो भवेत् ॥
 सोऽयं श्रीसोमदेवेन कथितोऽतीव निषितम् ।
 भूभुजङ्गशक्तीयोः^२ प्रकाश्यापद्मते^३ रजः ।
 रक्षयन्ति हि तत् प्रोक्तं धीतास्तु^४ रसवादिभिः ।

खरूपम् विनायेन पिण्डतापादम्^५ हि यत् ।
 विप्लुद्विर्जितः^६ सूतो नष्टपिण्डः स उच्चते ॥
 पथ यन्नापि वक्षन्ते रसताप्यनेकगः^७ ।
 समाक्रोक्ष यमासेन सोमदेवेन साप्रतम् ।

- (1) The text reads विवृक्षीतरा, which is incorrect.
- (2) The text reads तायि, which is not accurate.
- (3) The text has चपद्मते which is not accurate.
- (4) The text reads धीतास्तु, which is not correct.
- (5) But रक्षयन्ति reads सहितिर्जितः.
- (6) But रक्षयन्ति reads चर्मपतः.

जहं पातनयन्वं हि नम्दिना परिकीर्तिम् ॥

कोहि(ष्ट) काय अमेतहि नम्दिना परिकीर्तिम् ॥

विष्ण्याद्वौ हिमपर्वते च मलयी गोमलके त्रीगिरी
सद्गादावव पारियाचकगिरो किंकिंधिनामालये ।
माहेन्द्रेऽप्यथ चाल्पवत्तचितिघरे तदूपनामाधिकं
गोपाभीरकसिद्धवेदमुख्यतो वैष्णवः समावेशताम् ॥

इति श्रीकरवासभैरवपुरवरपतिश्रीसौभद्रदेवविरचिते
रसेन्द्रचृहामणो रससूक्ष्माने रसमहिम-
निरूपणं नाम प्रवर्मोऽध्यायः
समाप्तः ।

Extracts from
RASAPRAKASASUDHAKARA.
यशोधरविरचितात् रसप्रकाशसुधाकरात्
उडृताः श्लोकाः ।

विमलसूतवरो हि प्रकाष्टकं
तदनु धातुघटीपटकांचिकाः ।
पृथगिमाय चतुःप्रभागिकाः
स्फटिकशुद्धपत्ताष्टसमन्विताः ।
सह जलेन विमर्शं च यामकं
स्ववज्ञकाम्भजलेन विमिश्रितम् ।
उद्दितधातुगच्छ च मूर्खिकां
कुरु रसं विनिवेशय तच व ।
उमर्हवाभिष्यन्तवरेष तं
हिदशयाममष्टाचयवङ्गिमा ।
पवनपित्तकफचयकारकं
सकासरोगहर्वं परमं सदा ।

गजपतेर्बस्तवदृष्टिदो नृणां
 हिजपतीच्छवद्यनप्रदः ।
 सुवतिकामविलासविधायको
 भवति सूतवरः सुखदः सदा ।
 सघनसारसः किल कान्तिद-
 स्वस्तिस्तुष्टिहरः कथितो मया ।
 इति कर्पूररत्नः ॥

उदयभास्तरनामरमो ल्लयं
 भवति रोगविधानकरः ल्लयम् ।
 मगधिकामधुना मह गुच्छिका-
 वयमितय सदा परिसेवितः ।
 लक्षितकामविलासविधायकः
 स्वविरकोऽपि रत्नौ तस्मायते ।
 गदहरो वलदोऽपि हि वर्षदो
 भवति कर्म्मविपाकजरोगहा ।
 सकालसूतकश्चाविमन्त्रजो
 हिजवरेष मया प्रकटीकृतः ।
 इति उदयभास्तररत्नः ॥

अद्येदानीं प्रवक्षामि धातुगोधनमारचम् ।
 अनुभूते भया किञ्चित् किञ्चित्काशानुसारतः ॥
 सुवर्णं रजतं चेति सोहृ यज्ञमुदीरयेत् ।
 ताम्बं चैवाश्मसारस्तु नागवङ्गौ तथेव च ॥
 तीक्ष्णसोहृ निगटितं हितये रसवेदिभिः ।
 समिश्रसोहृचितयं सौराहृरौतिवर्जकाः ।
 एतेऽष्टौ धातुको ज्ञेया सोहृश्चेवं भवन्ति हि ॥
 अथ रसकगुणाः ।
 हिविधो रसकः प्रोक्तः कारबेहक-दुर्दरः¹ ।
 मत्स्यपाते परः प्रोक्तः प्रथमसोवधादिषु ।
 स तु² मेहहरयेव पित्तद्वेषविनाशनः ।
 रस्तनः पारदण्डाय नेत्ररोगचयापहः³ ॥

(1) The text reads धाती दुर्दरुः, which appears to be incorrect.

(2) The text reads तुल, which seems to be incorrect.

(3) The second hemistich is wanting in the text. We have adopted the reading of रक्तरसमुच्चय.

पारदो रसक्षेत्र देहसोहकरावुभौ ।
 नागाक्षुलेन कथितो सिंहो शेषो रसावुभौ ॥
 क्षतो येनाम्निसहनौ सूतखर्परकौ शुभौ ।
 तेन स्वर्णमयो सिंहिरर्जिता' च न संशयः ।
 रमको द्रावितः सम्यक् निचिसो रसपूरके ।
 निर्मलत्वमवाप्नोति मसवारं निमच्छितः ॥
 काचिके वाय तके वा नृमूले³ मेषमूलके ।
 द्रावितं चालितं¹ सम्यक् खर्परं परिशुद्धति ।
 खर्परं रेवितं शुद्धं स्वापितं नरमूलके ।
 रसयेत्तासमेकं हि ताम्रं स्वर्णप्रभं वरम् ॥

- (1) The text reads दिवी राजिता, which is not accurate.
- (2) The text reads विमच्छितं, which is incorrect.
- (3) The text has only नृले, which mars the metre.
- (4) द्राविते चालिते is the reading of the text, which is evidently an error.

वचाहरिदाचिफला-ष्टुहसूमैः ससेन्धवैः ।
 भग्नातकैष्टुपौख चारेराख्येय महितम् ।
 पादांशसंयुतैर्मूषां छन्नाकफलसर्वभाम् ।
 निरध्य शोषयित्वा च मूषामुखोपरि न्यसेत् ।
 प्रधाते सुपरे ज्वाला सिता नौका भवेदयदि ।
 लोहसंदंशके मूषां उत्त्वा छात्वा छाँधोमुखीम् ।
 भूम्यामाढालयेत् सत्सं यथानामं न भन्यते ।
 तदा सौषोपम्¹ सत्सं पतस्त्वेव न संशयः ।
 अनेनैव प्रकारेष वारचयन्नाते सति ।
 विनिःसरेत् सर्वसत्सं सहिंगु(?)गुच्छोदितम् ।
 अष्ट सौराष्ट्रोगुणाः ।
 सौराष्ट्रदेशे सप्ताता खनिका² तुवरी मता ।
 या लेपिता व्येतव्यो रक्तवन्धकरी हि सा ।

(1) The text reads ष्टिंत, which seems to be incorrect.

(2) रसरबमुखव् says षट्टामं. See Chap. II. Verse 161. ।

(3) The text reads खनिता, which is incorrect.

एकाहस्तप्रमाणं हि चतुरम् च गर्जकम् ।
 वनोपसस्त्वेष गर्जमध्यं च पूरितम् ।
 मूषिकां चौषधेनाय पूरितां ता तु मुद्रयेत् ।
 गर्जमध्ये निधायाय गरिष्ठानि^१ च निर्जिपेत् ।
 उर्ध्वाम्बिं व्याक्षयेत् सम्यक् सोऽयं गजपुटो भवेत् ।
 इति गजपुटः ॥

उपमं पिष्टकं काष्ठसुत्यलस्तु गरिष्ठकम् ।
 कृगचोपस्तसारौ च तचरां कृगचाभिधाः ।
 अरद्विमावे कुण्डे च वाराहपुटसुचते^२ ।
 इति वाराहपुटः ॥

वित्स्तिहयमानेन गर्जं चेचतुरस्तकम्^३
 कुण्डास्यं पुटं विषादीयधानास्तु साधनम् ।
 इति कुण्डपुटः ॥

- (1) रहरवलमुख बिरिष्ठानि.
- (2) रहरवलमुख बिराटी.
- (3) The text reads विषादीयधानास्तु साधनम्, which seems to be incorrect.
- (4) The text reads वर्ते कुण्डाचतुरस्तकं, which mars the metre.

जगचैरष्टभिः सम्यक् वापोतपुटसुचते ।

इति वापोतपुटः ॥

तुषेष्वा गोवरेष्वायि रसभस्यप्रसाधनम् ।

माचिकाद्यमानेन गोवरं पुटसुचते ।

इति गोवरपुटः ॥

सूदभाष्टे तु प्रपूर्वेष्व मध्ये द्रव्यं तु विश्वसेत् ।

प्रधस्ताक्षवालयेदन्मिं सूदभाष्टपुटसुचते ।

इति (सूद)भाष्टपुटः ॥

गते तु वासुकापूर्वे मध्ये द्रव्यं तु विश्वसेत् ।

उपरिष्ठादधस्ता॑ व वड्हि॑ कुर्यात् प्रयत्नतः ।

तद्वालुकापुटं सम्यगुच्छते शास्त्रकोविदैः ।

इति वासुकापुटः ॥

मूर्चिकां भूमिमध्ये तु सापितां इग्नुलादधः ।

उपरिष्ठात् पुटं दद्यात्¹ तत् पुटं भूधराभिधम् ।

इति भूधरापुटः ॥

(1) The text reads इत्ता, which is incorrect.

وَمُؤْمِنٍ بِرَبِّهِ وَلَا يُكَفِّرُ
وَلَا يَعْصِي رَبَّهُ وَلَا يَرْجِعُ
إِلَى الْكُفَّارِ إِذَا دُرِّجَ
وَلَا يَرْجِعُ إِلَى الْكُفَّارِ مَمْلُوكًا
أَوْ مَرْعُوبًا إِذَا دُرِّجَ
وَلَا يَرْجِعُ إِلَى الْكُفَّارِ مَمْلُوكًا
أَوْ مَرْعُوبًا إِذَا دُرِّجَ
وَلَا يَرْجِعُ إِلَى الْكُفَّارِ مَمْلُوكًا
أَوْ مَرْعُوبًا إِذَا دُرِّجَ
وَلَا يَرْجِعُ إِلَى الْكُفَّارِ مَمْلُوكًا
أَوْ مَرْعُوبًا إِذَا دُرِّجَ
وَلَا يَرْجِعُ إِلَى الْكُفَّارِ مَمْلُوكًا
أَوْ مَرْعُوبًا إِذَا دُرِّجَ

תְּמִימָה תְּמִימָה

1 :261ъылъ үз

ବ୍ୟାକିରଣ ପାଇଁ ମହାନ୍ତିରିତି

योऽशाश्वेन दातव्यं हुते ताम्रे सुधोभने ।

आयते प्रवर्द्धे इम शुद्धं वर्णचतुर्दश्यम् ॥

इति इमक्षिया ॥

स्वर्णमाचिकं संखोद्य काञ्जिके दिवसवयम् ।

चर्मारंग्या(गा)रसेनैव मर्हयेहिनसप्तकम् ।

जसेन धौतं तावश्च यावहेमनिभं भवेत् ॥

दरटं रसदेशीयं¹ गोमूत्रेणैव स्वेदयेत् ।

दोलायम्बेऽङ्गिः चत्वारि पशाङ्गुहतमो भवेत् ।

मनःशिला पश्चनिभा रक्ता चैव सुधोभना ।

स्वेदिता मुग्निपुष्पस्त्र रसेनैव तु दोलया ।

याममर्हमिता शुद्धा सर्वकाञ्चेषु योवयेत् ॥

नवसारस्तथा सूतः शोषितोऽन्विमति स्वसे ।

लब्धागार्णि मर्हाणि मर्हयेत्तिम्बूकारसैः ॥

मातुलुक्ष्मरसेनैव कुमारीसुरसेन वा ।

कूर्यातपे विमर्द्देऽसौ पाचितो जलयन्वके ।

दिनानि त्रौणि तौद्राम्बी कुर्यात्तदवतारयेत् ॥

(1) The text reads रसदेशीय, which is incorrect.

(2) अङ्गि [अङ्गिः] is grammatically incorrect.

शतांश्च वेधयित्वा रं युहैम प्रजायते ।
 जलभेदो यदा न स्वाच्छाव वार्ष्णा विचारता ।
 यित्या मारितं नागं कुमार्याः स्वरसेन तु ।
 पुटहादश्योगेन नागभय्य प्रजायते ॥
 शतसंख्यानि वै कुर्यात् पुटाक्षेव शरावके ।
 कुमार्याः स्वरसेनैव भावयेहि न समकम् ।
 पूर्ववत् पुटनं वासं शतसंख्यामितं तथा ।
 सूतगन्धयित्वाददुष्मं चेत्तागभयकम् ।
 विश्वहनोपलैटेव्यात् पुटं वाराहसंचकम् ।
 चर्मेन विधिना सम्बक् शतसंख्यानि दापयेत् ।
 पुटाक्षेव छातं चौचि शतानि हादशाधिकम् ।
 एषाहठे काचमये कूपे दाविश्यामकम् ।
 वास्तकामिं प्रदध्याश स्वाहागौतं समुच्चरित् ।
 तत्सभयं पहोतव्यं वेधयित्वा रुहैके ।
 युहैम भवेत्तेन नागं वार्ष्णा विचारता ।
 हृष्टप्रत्यययोगोऽयं न वितो नागं संशयः ॥

Extracts from RASACHINTAMANI.

मदनान्नदेवसूरिविरचितात् रसचिन्तामनि:
उद्गुताः श्लोकाः ।

सैन्धवं तोरिकां सूतं कासौसं लकुचद्रव्येः ।
विष्णुष्व खल्पभाष्टस्वं सवद्वस्त्वं दिनचयम् ॥ ७६ ॥
हृष्टकायां तटारीष्व काष्ठवर्हिष्टीयते ।
दिनव्रयैष्वतिक्रान्ते भस्म षेततरं भवेत् ॥ ७७ ॥

• • • • • • •

इति व्रयोदय मन्त्रसूतः ।

खण्डो वादशांशः चात् शिखिष्टीवं च तुत्वकं ।
षड्गुणं मातिकं निवभागं चाच्छं मनःशिळा' ।
भागवयमिदं चाच्छं श्रीभगवतकर्त्तरः ॥ ७८ ॥

(1) वापि नैवभावा नमःशिळा is the correct reading as stated in the margin of the text.

(2) वद्वा भावा वपि चाच्छाः श्रीभगवतकर्त्तरः is the correct reading as stated in the margin of the text.

गंधकवयमेवास्ते काचमाचोरमेभूयः ।
 दिनसप्तमाव कर्त्तव्या भावना महेन्द्रमात् ॥ १८ ॥
 अधोमुखेन यन्त्रेष तेन निःसारयेद्गुष्ठः ।
 सत्यं तद्रसकस्ताव हृष्टं कार्यकरं परं ॥ ४० ॥
 अवश्यं तहृष्टं सत्यं निर्धमं कामसाधनं ॥
 इति रसकसत्यपातम् ।

विवारं गन्धकहतं तामृहे महयवयं ।
 सत्यं तालस्य मासैकं योजयेत् सर्वकामदं ॥ ४१ ॥
 अन्नवण्डं भवेहेमं तामृगंधकमारितं ।
 एतद्योदीर्घिते रम्यं जायते कांचनं शुभं ॥ ४४ ॥

इति शोमदनांतदेवविरचिते रसचिंतामणी
 हेमीकरणप्रयोगः ।

पारदं सौसर्कं मध्यं छुनटो तथतुष्टयं ॥
 बौबपूराभसा पिष्टा बाढ़ं दिनसतुष्टयं ॥ १०८ ॥
 अथ सूख्याचि पचाचि तेन तारस्य सेपयेत् ।
 बौबपूरसेनैतत् त्वृतिमात्रान्वितापितं ॥ १०९ ॥

एकाचिका भर्वत्स्व भावनाशास्त्र विंशति ।

विशेषावस्तिंत तारं भवेत्तारस्त्र कांचनः ॥ ११० ॥

इति चिंतामणी हेमीकरणप्रयोगः ॥

हेमभागद्यं तारं तथा ताम्ब चतुष्टयं ।

एकातः क्लियते पचमतिसूख्यं निरामयं ॥ १११ ॥

जंबीरनीरसंपिण्ठं सुपर्स्याष्टटकणं ।

तेन ताम्बय पदाचि सेपनीयानि वै वडु ॥ ११२ ॥

आवर्तते पुनर्देखा मूषके गलितानि च ।

तदा तानि भर्वत्स्वं हेमरूपाचि नाम्बया ॥ ११३ ॥

इति हेमीकरणप्रयोगः ॥

एकभागो भवेदारः तारं भागद्यं भवेत् ।

वेदभागं भवेत्तीस्त्रं सत्त्वं सत्त्वाश्च वै दश ।

बंमभागं भवेत्पद्मं सर्वमेकत्र वारयेत् ॥ १०८ ॥

टंकचेन पुनः आतं पचं छात्वास्त्र वस्तुगं ।

वेसाचयमिदं आतं तत्रमध्ये निवेशयेत् ॥ ११० ॥

एवं तारं भवेत्तुनं परीचाश्चममापये ।

इति तारोत्पादकां ॥

तुत्वकं पित्तते चले चिफलाहिंगुट्टकणः ।
 मध्यात्मनिश्चितं आतं सर्वं पातयते भृवं ॥ ६८ ॥
 इति तुत्वकसुत्वपातनं ।

खण्डः स्तेष्वते पूर्वं कौलत्येन वसेन च ।
 वटारोहजसेनापि पर्वचूर्णेन शोभनः ॥ ६५ ॥
 गुड्टकशमित्रजिफसाद्वायमदिंतः ।
 मध्यये कूपके छाला धात्वमानो सर्वं च सः ॥ ६६ ॥
 शेत्वधूमोदगमे वाते तत उत्खाप्य कूपवं ।
 सावधानं करेषेव भूमौ तं चाप्त आनयेत् ॥ ६७ ॥
 पुनर्व धात्वते कूपः तथाजातं च तं पुनः ।
 कूपकं च पुनर्भूमौ तथा तं नामयेत् पुनः ॥ ६८ ॥
 सर्वं खुर्परक्षेतत् नागर्क्षणं पतत्वघः ॥ ६९ ॥
 इति खुर्परत्वपातनं ।

Extracts from RASAKALPA.

**कद्रवामलान्तर्गतात् रसकल्पादुच्छृताः
स्मोकाः ।**

गिवं नत्वा रसाष्ठीशं चक्षिकाचरणं तदा ।
क्षियते^१ रसकल्पोऽयं रसज्ञानविशारदः^२ ॥ १ ॥

। पठ परीक्षा ।

पतेजा पगुहः शम्भो लोहड़ा^(३)पश्चको रसः^४ ।
यदा^५ नावार्त्तयेहड़ो नोहै मध्येतदा यूतः ॥ ४० ॥

(1) The text reads करीनि, which is grammatically incorrect.

(2) The reading in the text is विशारदम्, which is incorrect.

(3) The text reads रु, which is incorrect.

(4) The text reads उदामावर्त्तेत्, which is not correct.

दन्ते नृहे मयो वेषो रथयेत् साधितं रसम् ॥ ४२ ॥
 इति चौचत्रयामस्ते रससंकेतकं नाम
 प्रवर्णोऽपासः ।

हेमरुप्याकंवज्ञाहि'लोहा लोहाः^१ वज्ञोरिताः ।
 अद्विमा इमे यिवां वर्त्तायाः स्युसु^२ लोहिमाः । १ ॥

सन्तो वज्ञालिपुटो युग्मान् विज्ञापयाम्बद्धम् ।
 छपात्तुवारसदुता हृष्टिर्यन्ते प्रदीयताम् ।
 महारसाः स्युसामादावष्टी पारदहिङ्गुते ।
 वैश्ववं शस्त्रकं शैलं चपलं रसकोऽमलम् ।

(महारसाः)

- (1) The text reads वज्ञाहि, which is grammatically incorrect.
- (2) लोहिमाः is the reading of the text, which seems to be incorrect.
- (3) The text reads रेतानीयात्तिमा, which is palpably an error.

अम्बकं तुत्यकं वालं राजावर्तमयाद्यनम् ।

वज्रं वेङ्गाम्लकं चेव टह्यां च रसा वहु ।

(रसाः)

गम्भकं तालकश्चिनि कितिष्ठेचरगैरिकाः ।

इत्यादयसीपरसाः सर्वाचार्येष्टदीरिताः ।

(उपरसाः)

सितासिताहर्षं पीतं गम्भकं तज्जतुविधम् ।

तालकं हिमकारं स्वात् गोदकः पाटकश्चविः ।

रसा पीता शिळा हेधा पूर्वा वेष्टोत्तराद्यमाः ।

वहुप्रकारा सौराद्धी कासीसं चिविधं मतम् ।

कासीसं पुष्पका सीमं हीरकासीसमित्यथ ।

गैरिको हिविधः प्रोत्तः सौवर्णी सोहितस्तया ।

(1) The text reads वेष्टोत्तराद्य, which seems to be incorrect.

(2) पुर्वा वेष्टोत्तराद्य is the reading of the text, which is incorrect.

(3) The text reads कासीहिविधी मतः, which is incorrect as it is mentioned neuter in the next line.

कहु छादीन्^१ रमान् केचिदचर्या वर्णयति वै ।
अस्माभिरिह ततोत्तमं सुनिमार्गानुषारिभिः ॥

इत्येष प्रोदितो मार्गो रसशोधनकर्मणि ।
सत्कर्मदभैरवाव्युत्तो गोविन्दादित्याहृतः^२ ॥

सत्यां चूलिकोद्भूतं गन्धकेन समन्वितम् ।
सर्वाङ्गदद्वयः^३ चिक्राद्वै मूलभासाप्रगासितम् ।
गोमूचेष शतं भाव्यं तद्रसे जारयेत् गनी^४ ।
तत्त्वं संपर्कतः सूतो रात्रसो भवति भ्रवम् ॥

- (1) The text reads कहु छादीन्, which is an error of the scribe.
- (2) The text reads रमानिः, which is incorrect.
- (3) The text reads चूलिदद्वय, which seems to be incorrect.
- (4) गनीः, as given in the text, is grammatically incorrect.

एतदेव विद्धुं दद्यात् सम्बद्धा हेमवारचौ ।
 मुखं संवायते तेन जीर्ण्यते च^३ विनिश्चितम् ॥
 इति त्रौद्रद्वयामले रसकल्पे उमामहेश्वरसंवादे
 रसाधीषमप्रकारः ॥

इति संधानयोगीऽयं जारखेऽतिगुच्छावचः ।
 प्रकाशितः संप्रदायक्रमप्राप्तः शिवोदितः ॥
 इति त्रौद्रद्वयामले रसकल्पे उमामहेश्वरसंवादे
 रसाधिकरचौ^३ नाम हितीयोजासः ॥

महारसानां सम्बेदां रसानां शुद्धिदृशते ।
 तदैकोपरसानां शाखाहृषेन वर्तना ॥ १ ॥

कटकौपचञ्जीर्णीरैः माल्कोकं भावयेत् शतम्^४ ।
 गन्धवं तैलमध्यात्म्य-पद्ममेकं दिनवयन् ॥

- (1) The text reads हेमवारचौ, which is not correct.
- (2) The text reads च, which appears to be an error.
- (3) The text reads रसाधिकारेषा, which is incorrect.
- (4) The text reads शृणु, which is senseless.

तत्तात्यं वद्यनूपायाऽ पक्षायां निश्चिपेत्ततः ।
 मोहसम्भागकरणं तत्समं तत्र निष्पचेत् ॥
 हृदां प्रकार्ययिन्द्रूपाऽ कोष्ठिके विनिवेश्येत् ।
 पक्षादेः स्वदिरोहृतैः धमेदभक्षाइयेन वे ॥
 वक्षनासुवा सस्वं तात्यस्त्र पतति ध्रुवम् ।
 गुह्यदीपिः सुशब्दस्त्र यदा वैश्वानरो भवेत् ।
 तदा सस्वं तु पतितं ज्ञानोयाकाम्यया क्षचित् ॥

रसकं स्वेदयदादौऽ पटुचूर्णलतं दुषः ।
 चतुर्गुणेन वस्त्रेष्व हृदं वक्षा च डोकिकाम् ॥

(1) वक्षसात्त्र वक्षम् वा is the reading of the text, which appears to be incorrect.

(2) The text वक्षकपेन्द्रूपा is evidently incorrect.

(3) कीष्टिकामि निष्पेश्वेत् is the reading of the text, which has no meaning at all.

(4) The text reads वक्षस्त्र, which is grammatically incorrect.

(5) रहकाइदेहादौ is the reading of the text, which seems to be incorrect.

सत्त्वा भाष्टे च सुजसे^१ स्त्रेदयेकासपश्चकम् ।
 उहृत्य पवाद्रसकं लक्ष्मधे^२ विचूर्णयेत् ॥
 पादोशान् मासतीवातं सगुड़^३ जीर्णगुण्डकम् ॥
 गृहधूमं रेवकीं च निशामं कुलजीरकान्^४ ॥
 तत् सर्वे चृचिंतं सत्त्वा गोपन्तकविभावितम् ॥
 सत्त्वा तद्वट्टिकाः पवात् छायायां शोषयेत्ततः ॥
 कोहगेनाम्निना^५ पवाहमेदमच्चाहयानितः ॥
 सत्त्वं पतस्वसंदेहं क्षिररक्तं हृढ़ं बहु ॥
 एकमासं हिमासं वा रसकं स्त्रेदितं यदि ॥
 न आतव्यं तज्जोहे धमित्तत् नालमूषया ॥

— —

इति सम्बादितो मार्गो द्रुतीना पातने स्फुटः ।
 साच्चादनुभवैर्हष्टो न चुतो गुबदर्शितः ॥

- (1) इत्ता भाष्टेन लक्ष्मे is the reading of the text, which is incorrect.
- (2) The text reads लक्ष्मधे.
- (3) The text has जीरक, which is grammatically incorrect.
- (4) The text reads जीर्णकविभाविता, which is not correct.

सोकानासुपकाराय एतत् सब्दे निवेदितम् ।
 सर्वव्यां चेव कृष्णानां द्रावणं परिकौर्तिन् ॥
 इति श्रोद्ध्रयामले रसकल्पे उमाभेष्यरसंवादे
 सर्वसोहद्वितिपातन् ॥ अकारः समातः ॥

Extracts from RASARAJALAKSHMI.

विष्णुदेवदिरचितायाः रसराजलक्ष्मा:

प्रारम्भः—

यस्येच्छाहुरवद्वरौ मुकुलिता नामाकसाकौतुकैः
 चाठुर्येकविसोतपद्मवती कौर्तिप्रसूनप्रसूः ।

(1) उन्नाम् द्वन् is the reading of the text, which is not correct.

संनिर्बापयति अरवदयमहो ज्ञायाकसापैर्मृषा
सोऽयं पातु विशारमूर्तिरचिलं कालापलौढं अगत् ॥१॥

अथति दुरितसर्पसांडमंब्रोषदपः
प्रबक्षगदविनाशः सेविविष्वस्तनाशः ।
शिव इव विज(वीज ?)भंकः उंहितायोगमंदः
विपुरइरतनूवस्तोषसः कायपुंजः ॥ २ ॥

इति श्रीपञ्चतमहादेवतगयत्रीविष्वदेवविरचितादा
रसराजसचारासुकासु प्रथमः ।

हहेम रससागरं शिवकृतं श्रौकाकाचक्षेष्वरी-
तन्वं सुतमहोदधिं रससुधाच्छोधिं भवानीमतम् ।
व्याडिं सुन्तुतसूचमौष्ठुदयं स्वच्छंदशक्त्यागमं
श्रौदामोदरवासुदेवभगवदगोविष्वनागाजनान् ।
प्रथमः उक्तासः ।

स्वच्छंदशक्त्यागमसारभूतः
उसुहृतो विष्वमिष्वरेष ॥ ११० ॥
कितौयः उक्तासः ।

पासोऽस्तु सुनुतं हन्दहारोत्तरवादिकान् ।
आदेव वामटं लिङ्गारं दामोदरं गुरुम् ॥

दत्तौयः उक्ताः ॥०

• Poll. 1—43. Linn. 10. Rasarājālakshmīs, de medicamentis metallorum et fossilium ope conficiendis liber, a Rāmēvara (bhatta), Vishnus filio, compositus. Incipit : चामदेवरसे विष्वकूरवानिसुखोचाक्षिं प्राप्यकाविश्वेति-
वपत्तै etc. ॥ १ ॥ सदिमुखीमंदनमंदनैः (i. संमुखी०) sphurad
Rasāmbhodhi-gabbīragarbhbāt ; s'rī-Vishnudevi (o devi)
labhate prayatnāt s'rī Vishnuvatsād Rasarājālakshmīm
॥ २ ॥ Drishtvemam Rasasāgnram, S'ivakritam s'rī-Karka-
chandes'varstaṇtram, Sótamahodadhim, Rasasudhām-
bhodhim, Bhavānismatam, Vyādi(m), Sus'rutasūtram,
Is'abridayam, Svachobhandaśaktiyágamam, s'rī-Dámoda-
ra-Vásudeva-Bhagavad-Govinda-Nágárjucán ॥३॥ चामद-
नामदेवरं १८७ चामदेवरं विष्वकूरगुरुम् । वीक्ष्णीयं अपरीक्ष्णीयं
वीमहमुद्दिष्ट नमामि ॥ ४ ॥

महारथाः सरकाराददौ पाददहिंदुमि ।

देवता दक्षकं देवता चपत्तं रसकोमकम् ॥ ५ ॥

चपत्तं तुष्टकं (tutthakam) कामं राजावस्त्रकामम् ।

वक्त्रांकात्काम (o vaikrántakam) विति टक्कं च रक्षाचित्तः ॥६॥

वामकं वरकाहिषि विष्विश्वरवेरिकाः ।

इवादवसोपरतः पूर्णचार्यवदोरिताः ॥७॥

Aufrecht's "Catalogus," p. 321, No. 761.

Colophon at the end of the Rasarajalakshmi—

राजन् (संश) शार्वरिक राजदिवसे वारे हिमांशोरिद
 चंचदभूतक्षयत्तमे विजयिनि श्रीबुद्धपृथ्वीपतेः ।
 शास्त्रं वैद्यक साररूपम करोत् श्रीविष्णुदेवः कविः
 वाग्देवीचरणारविंदमकरंदामोदसौरभवाक् ।

—

Extracts from RASANAKSHATRAMALIKA

मध्यनसिंहविरचितायाः रसनक्षत्रमालिकायाः

उद्भूताः श्रीकाः ।

चतुर्बतः शंखकपर्हिकानां
 सतत्कर्म्मीरविमहितानाम् ।
 चापेनमाचीकविषद्यानां
 पल्ले पल्ले दक्षिणक्षाम्बितानाम् ॥ २५ ॥

—

यतमस्यगन्धस्ता हितयं वृक्षस्य शुद्धतीत्त्वात् ।
 दध्ना मग्स्य शुद्धं विगुणं दत्ता रसार्थविषम् ॥ १२३ ॥
 चित्तवायोत्तिथिवाहृषदश्मूलदिवनदिविलगिरः ।
 कलहसारविळतकैः प्रत्येकं भावनवितयम् ॥ १२४ ॥
 दत्ता सुसिद्धमात्रो मारिचधूपेन धृपितः सम्बद् ।
 स्वच्छन्दभैरवास्था रसः समस्तामयस्वंसो ॥ १२५ ॥
 चिकट्टकरसेन युक्तो विशेषतः सुखिपातहरः ।
 यहचिंगदामयशूलब्रह्मविट्ठिवातगुल्मजयी ॥ १२६ ॥
 इति स्वच्छन्दभैरवो रसः ॥*

इयं मात्रविभूपासभिवज्ञा भिषजां मता ।
 ज्ञाता मवनसिंहेन रसनश्वरमालिका ॥ १४२ ॥

इति रसनश्वरमालिका समाप्ता ॥ अस्मि
 संवत् १५५० आश्विन ऋष्ण ५ सोमे ।

* The अस्मिन्द्वय रस mentioned in the रसनश्वरमालिका is quite distinct from that, which is stated in the रसिन्द्रियकामिकि. Neither has it any analogy with what is described in the रसरबहमुख्य.

Extracts from
RASARATNAKAR

नित्यनायविरचितात् रसरत्नाकरात्

उदुताः श्रीकाः ।

यदुतां शशुना पूर्वं रसखणे रसार्चवे ।
 रसम् वन्दनार्थं च दौपिकारसमङ्गले ।
 व्याधितामां हितार्थाय प्रोत्तं नामार्थुनेन यत् ।
 उहं चर्णटिसिहेन⁽¹⁾ कर्गेष्वकपालिके ।
 अनेकारसगाढेव सहितास्त्राममेतु च ।
 यदुतां वाभटे तत्के सुशुते वैष्णवागरे ।
 अन्येष वहुभिः सिहैः यदुतास्त्र विनोद्व तद् ।
 तत्र यद्यदसाध्यं स्याद्यद्यदुर्ज्ञमनोवधन् ।
 तत्तत् सर्वं परित्यज्य मारभूतं समुद्दतम् ॥
 कर्विष्वासे क्रिया नास्ति क्रमवापि च चक्षित् ।

(1) चर्णटिसिहेन is the reading in the Sanskrit college BIS.

ପ୍ରାଣିକାରୀ ପ୍ରାଣିକାରୀ ।

ଦେଖନ୍ତି କିମ୍ବା କିମ୍ବା କିମ୍ବା ।

ଦେଖନ୍ତିଥିଲୁ ।

ଦେଖନ୍ତି କିମ୍ବା କିମ୍ବା କିମ୍ବା ।

ଦେଖନ୍ତିଥିଲୁ ।

ଦେଖନ୍ତି କିମ୍ବା କିମ୍ବା କିମ୍ବା ।

ଦେଖନ୍ତିଥିଲୁ ।

ଦେଖନ୍ତି କିମ୍ବା କିମ୍ବା କିମ୍ବା ।

नष्टपिष्टन्तु तदगोमं हिङ्गुना वेष्टयेहङ्गि ।
 पचेह वस्य वस्त्रात्म्यं दिनैकं चण्डवङ्गिना ॥
 जाह्नवीतम्बं समादाय ढूँ वस्त्रेण वस्त्रयीत् ।
 जाह्नवीधो गन्धकं तुर्स्यं दस्त्रा सोमानसे पचेत् ॥
 जीर्णं गन्धे पुनर्देयं घड्भिर्वरेः समं समम् ।
 घड्गुरे गन्धके जीर्णं मूर्च्छितो रोगहा भवेत् ।
 चतुर्थोपदेशे ।

—

Extracts from DHATURATNAMALA.

धातुरत्नमालायाः

प्रारम्भः—

प्रथम्य वितर्तीं शक्तिं विसृष्ट्यज्ञिकारिणीं ।
 धातुरां रब्बमासायामभिधायं करोम्यहं ॥ १ ॥
 नद्यविसृष्ट्यरायान् ये मर्ता व्यायंति नित्यधः ।
 इन्दानपदानाय सा मे विश्वेश्वरी मता ॥ २ ॥

अथ धातूनां रसमालां वस्त्रामि ।

रोप्यं देहं तथा ताम् नागं वंगं तथायसुं ।

खुर्पेराभक्तमोहं च प्रवालं ताक्षकं शिला ॥ ३ ॥

सुवर्षमाचिकं सूतं हौरकं च ब्रवीम्यहं ।

सर्वधातूपधातूनां सचर्णं मारणं गुरुं ॥ ४ ॥

अथ रौप्यमारणं ।

रोप्यं शुद्धं समादाय नागेन गुरुं शोधयेत् ।

शुद्धे तारे पुनः पवात् सूच्यप्राचि कारयेत् ॥ ५ ॥

निंबचिचिद्राचामिः शोधयेत् पूषक् पूषक् ।

चालयिदुदकैः साते तथा दुर्घेन शोधयेत् ॥ ६ ॥

गंधपारदयोरैकं किञ्चिद्दुग्धं च घर्षयेत् ।

द्राचाया द्रवसंसुक्तं तारपचाचि शोधयेत् ॥ ७ ॥

चन्द्रायन्ते विनिचित्य सेपयेद्रवस्त्रमत्तिकां ।

क्षिपेदगणपुटे गते ज्वासयेद्रवहुक्तानकान् ॥ ८ ॥

समाप्तिः—

संक्षो वैष्णवनामाय रससिद्धांतसागरात् ।

धातूनां रसमाला च ततो वैष्णव्य हेतवे ॥ १७६ ॥

मरचेभ्यो भयदस्ता दीगदस्ताच वै नराः ।

रद्धमाला ज्ञाता तेषां वैश्यानां च हिताय वै ॥ १७७ ॥

इति श्रौतैष्यकशास्त्रे अज्ञिनौकुमारसंहितार्था

घातुरद्धमालायां समातोऽयं पंचः ।

The following is taken from Aufrecht's
"Catalogus"—No. 760.

Incipit :—प्रणम्य सारदां शत्रिं खट्टेदसत्ति-
कारवां । घातुनां रद्धमालां च विशेषाव करोन्वहं ॥ १ ॥ ब्रह्मविष्णुद्वारान् ज्ञायेद्वत्ता ज्ञायति नित्यम् ।
तेषां वरप्रदानाच मा भयेवसुदीर्घते ॥ २ ॥ कृष्णं
केम तथा ताम्ब नाग वंग तथायसं । रुद्धरं गगनं
प्रोक्तं प्रबालं तालकं शित्ता ॥ ३ ॥ मात्तिकं गंधकं
सूतं हौरकं च ब्रह्मयहं । सर्वधातूपधातुनां सूचयं
मारणं गच्छान् ॥ ४ ॥ कृष्णं शुहं समानीय नाग-
मूषा तु शोधयेत् । शुहे तारे पुनः पद्मात् द्वच्छ-
पत्राणि कारयेत् ॥ ५ ॥ निंबुचिंचिचीद्राचाम्भिः शोधनीयं
पूषक् पूषक् । चालयेदुदकौः सार्हं तदा दुष्प्रेन
शोधयेत् ॥ ६ ॥ गंधकं पारदं कृष्णं विंचिदूर्वगं च

चर्येत् । द्राक्षारसेन संयुक्तं तारप्रवाचि लेपयेत् । ७ । नर्तं यन्मे विनिश्चित्य लेपयेद्वस्त्रमृतिकां ।
सेप्तं नजपुटे नर्तं ज्वालयेत् यहोपलैः ॥ ८ ॥

In fine libelli disticha haec legantur :
 यद्यो वैष्ण [क] नामायं Rasasiddhántaságarát ।
 धातूना रद्धमाला च छाता वैष्णसुहेतवे ॥ १ ॥
 मरणेष्यो भयवस्ता रोगप्रसाद ये नराः ।
 रद्धमाला हि धातूना छाता तेषां हिताय वै ॥ २ ॥
 Jātyá Gurjarkhaṁlaṁ cha, Devadatto
 hi dharmavit ।

Harer nāmābbidhánasya सुतसाम्ब मिष्वरः ॥ ३ ॥
 संहितारसकर्माणि यस्त वृद्धिगंरीयसी ।
 तेन शास्त्रविधिश्चेन छाता रद्धमा मालिका ॥ ४ ॥
 इति देवदत्तछातवैष्णकशास्त्रे धातुरद्धमाला ॥



Extracts from RASAPRADIPA.

रसप्रदीपादुचृताः स्मोकाः ।

A—MS. from Alahabad.

B—MS. from Benares.

अथ शङ्कद्रावरसः ।

स्फटिका^१ नवसारब सुषेता^२ च सुवर्जिका ।
 सूयक् दयपलोच्चानं गन्धकः पिचुसंमितः^३ ॥
 चूर्चयित्वा छिपेद्वाष्टे मृगये मृदविलेपिते^४ ।
 तसुसं मुद्रयेत् मन्यक् मृदभाष्टेनापरेण च ।
 सरन्ध्रोदरकेणैव चुक्रां तिर्यक् च धारयेत् ।
 अधः प्रज्ञासयेहङ्गि हठादयावद्भसः ऋचेत् ॥

- (1) A reads घटिका, B reads घुटिका.
- (2) B reads सुषेता, which is not correct.
- (3) B reads पिसंमिता, which is not correct.
- (4) मृदि' लिपिते is the reading in B.

शारेकं सेवयेद्यज्ञात् । दक्षाज्ञविवर्जितम् ।
 गुरुदोदरयज्ञातप्त्रोऽपनियज्ञादिगृह्णतुत् ।
 वसपुष्टिपदो श्चेष्मुक्तं च जारयेत् त्वचात् ।
 विसोक्षतां महासोका रसमाहात्मगम्भृतम् ।
 कपहंकाश सोहानां यज्ञिन् चित्ता^१ मलमिति हि ॥

फिरहृष्ट्याधि:—

गैरिकं रसकार्पूरम् उपका च पृथक् पृथक् ।
 टहमाच विनिविष्ट^२ ताम्बूकीदक्षजैः रसैः ॥
 वद्याद्यतुहृणास्तेषां^३ कर्मचा भिषगुप्तमैः^४ ।
 सायं प्रातः समग्रौयात्^५ एकैकां दिनसहकाम^६ ॥

- (1) B reads वसा.
- (2) A reads चित्ता.
- (3) A reads विनिविष्ट.
- (4) A reads चतुर्दशेषो षष्ठी । B reads चतुर्दशेषो षष्ठी ।
- (5) B reads भिषगौतमौ, which is incorrect.
- (6) B reads समक्षीयात्, which is incorrect.
- (7) हिमवपूर्व an incorrect variant in B.

सप्तता योक्तिका' देया भोजनावे निरन्तरम् ।
फिरहुव्याधिनाशय बटिकेयननुत्तमा ॥

(1) गोप्तव्यरीटिका पद्धतिः-

* The following is taken from शीखतराहिती of Trimalabhatta, printed in Bombay in the S'aka year 1810.

त्वं तु विहे उमडसमाप्ते
निधाव सूतस पवानि पंच ।
सप्तोक्तव्याधिकटिकेटिकामा
समीरिषामा तुवरीयुवामाम् ॥ ५० ॥
सप्तोक्तव्याधिकटिकेटिकामा
पूर्णांटक चोपरितो निरुचाम् ।
सप्तोक्तव्याधिकटिकेटिकामा
पिण्ड रक्षीयन अरावमिकम् ॥ ५१ ॥
सप्तोक्तव्याधिकटिकेटिकामा
राज्ञादयेन छर्पत्रिविंशतिः ।
सप्तोक्तव्याधिकटिकेटिकामा
संस्कार भगुटा हठं तुषुकाम् ॥ ५२ ॥
सप्तोक्तव्याधिकटिकेटिकामा
लंकाव उचोपरि वस्त्रमाईम् ।
सप्तोक्तव्याधिकटिकेटिकामा
तन् काङ्गोत्तं परिदृष्ट युद्धा ॥ ५३ ॥

—بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

पलाईमानः सूतः स्वात् षट्पलोऽव गुडः सूतः ।
 एकीष्वास्त्रिलं कुर्यात् वटीः कर्षप्रमाणतः ।
 चादेदेकां वटीं प्रातर्यावदारोऽदर्शनम् ।
 गोटभृत्यानुपानेन फिरहामयनाश्विनौ ।
 निमुकेन^१ विना नेत्र वर्जनौयमिहापरम् ।

अथ उपायान्तरम्—

चोपचीनीमवं चूपं शाष्टमानं समाचिकम् ।
 फिरहाष्ट्याधिनाशय भवयेत्तद्वर्त्तम् ॥

— — —

(1) B reads फिरहाष्ट्याधिनाश्विनौ.

(2) B reads निमुकेन.

Extracts from DHATUKRIYA or DHATUMANJARI.

रुद्रयामले धातुक्रिया धातुमञ्जरी वा । *

श्रीगणेशाय नमः ।

पार्वत्युवाच ।

अथानन्तर^१ देवेण गूहि धातुसुसंस्कृतिम् ।

येन विज्ञानमात्रेण साधयेहातुसंज्ञितः ॥ १ ॥

महादेव उवाच ।

धातुसुर्वविधः प्रोत्तः तर्यसुर्वे सप्ततः (?)^२ ।

सत्यं रजस्तमस्य चतुर्थस्तु निरामयः ॥ २ ॥

* The Ulwar MS. (A) reads धातुक्रिया, a part of the Rudrayāmala ; but the Benares MS. (B) reads धातुमञ्जरी, a part of the same. The two MSS. are exactly the same in subject matter, differing only in name.

(1) A reads अथानन्तर, which is grammatically incorrect.

(2) A reads धातुमञ्जरी, which is grossly incorrect.

(3) The sense here is not clear.

राजसि राजसी सिद्धिकानसे तामसी चदा ।

सत्त्वसाधनं सात्त्विके आनीते^१ सर्वसाधनम् ॥ १ ॥
पार्यंकुलाच ।

काष्ठता देवदेवेश सत्त्वं राजवतामसम् ।

अतीव गुणवत्^२ धातोः कार्यं लच्छसचितम् ॥ ४ ॥

उपधातुकमेचैव तेषां लच्छसाधनम् ।

विटको च मुदा युद्धा तेषां कार्यसु^३ साधनम् ॥ ५ ॥

उपकारो^४ गुणकाचं नाना कार्यक्रिया युभा ।

वियोगयोगचास्त्रस्वं वर्णमेदेषु मारणम् ॥ ६ ॥

समयं देवदेवेश विषेषा धातुकात्क्रियाः ।

येन विज्ञानमादेष साधयेत् गन्धकोः क्रियाः ॥ ७ ॥

- (1) A reads चमीते, which seems to be incorrect.
- (2) A has गुणती, which appears to be incorrect.
- (3) कार्यं लच्छवदिताः, a variant in A, which is not correct.
- (4) A reads erroneously कार्यम्.
- (5) A reads उपकार, which is grammatically incorrect.

महादेव उवाच ।

सूर्यिष्या गर्भमध्ये तु प्रनेका धातुर्मिहति^१ ।

विश्वता^२ कियत्कालेन धातुर्नानाविधोदिता^३ ॥१॥

गुणसत्त्वसंयुक्तां^४ साम्रातं न अरामि ह^५ ।

कवृं से कथयिष्यामि^६ वद नम्नाङ्गवासिनि ॥ ८ ॥

पात्वस्तुवाच ।

ये केचित् सर्वाणां रूप व्याप्तं कवय साम्रातम् ।

भवतोऽनुप्रहेष्येव साक्षनावेदं सिधति ॥ १० ॥

(1) धनेका धातु विहति, a variant in A, which treats the word धातु in the neuter as well as in the feminine genders

(2) A reads विष्वता, which is not correct.

(3) धातुर्नानाविधीदिता, an incorrect variant in A.

(4) A reads संयुक्ता, which is grammatically incorrect.

(5) A reads अरति ह, which is incorrect.

(6) कवयामास is the incorrect reading in A.

(7) A and B read अरति, which is grammatically incorrect.

(8) अरदा is the reading in A and B, which is not correct.

(9) धातुर्नानात् is the incorrect reading in A and B.

महादेव उवाच ।

नृण् देवि प्रवच्छामि धातुं नामा विधस्ति ति॑ ।
 गुणलक्षणसंयुक्ता यथा तुष्टिः^१ कवचति ॥ ११ ॥
 मुख्यप्राधान्यता^२ एते रक्तसोङ्कर्ताम्बकैः ।
 रक्ततेजैश्च संयुक्ता धातोरक्तमता सदा ॥ १२ ॥
 मध्यमा सत्त्वजा धातुः^३ नीचा च वपुषीसयोः ।
 संयोगी वातुनामा हि नीचा नीचतरा अ॒ता ॥ १३ ॥
 संयोगात्वे विधा प्रोक्ता उक्तमा मध्यमाध्यमा ।
 ताम्बजासत्त्वयोर्योगे^४ नारीवातुः प्रवायते ॥ १४ ॥

(1) A and B read तुष्टा

(2) मुख्यप्राधान्यता is the correct reading. शास्त्राभ्यां ता is grammatically incorrect.

(3) A and B have रक्तसोङ्कर्ताम्बैः, which mars the metre.

(4) A reads रक्ततेजैश्च, which is not correct.

(5) अ॒ता is used here in the feminine gender both by A and B.

(6) Vide verse 20.

एवा^१ मध्योत्तमा प्रोक्ता कार्यकारणयोगके ।
 अपुताम्बसंयोगीन^२ जाता धातुष मध्यमा ॥ १५ ॥
 सौसके^३ भङ्गदा प्रोक्ता कार्यकाले सदोदिता ।
 अनेनैव प्रकारण येन येन च कर्मसु ॥ १६ ॥
 कर्तव्या आघवो विद्या ज्ञात्वा^४ बुद्धिविश्वारदेः ।
 अभङ्गं सौसके जातं यह उत्पत्त्यकारकम् ॥ १७ ॥
 हाटके घेतता जातेः^५ अचया^६ रजते यदि ।
 नघुद्रावः यमे यस्ते सोहे च द्राविषो चक्षा ॥ १८ ॥

(1) Both A and B read एवा, which is grammatically incorrect.

(2) उंचीवि is the reading in A and B, which mars the metre.

(3) A and B reads शीषकै.

(4) A reads जाता, which is incorrect.

(5) A and B read जाते, which is incorrect.

(6) A reads चक्षो. B reads चक्षी. Both the readings seem to be incorrect.

जासते पहुँचीना च काठिक्षाभविकौ परौ ।
 कला एताव धातुनां जातेभवति शुद्धता^१ ॥ १८ ॥
 कला एताहयो दिव्याः प्राप्तः^२ शिष्टसु जायते ।
 गुरुजासत्त्वसंयोगे नारोधातुसु^३ जायते ॥ २० ॥
 कार्यानिककरौ प्रीता पादामोदसु^४ कोमला ।
 मारणे जारणे दिव्या चारणे बोटने तथा ॥ २१ ॥
 निर्गंधा वर्षरहिता जातिभेदकरौ छृता^५ ।
 एतावद्^६ गुणसंस्पृशा कार्यकारणसंयुता ॥ २२ ॥

(1) जाते भवति शुद्धता, a variant in A. जाते भवति रहिताः, an incorrect variant in B.

(2) A and B read शान्ते, which is grammatically incorrect.

(3) A reads नारीष्ववसु. B reads नारोष्ववसु. Both seem to be incorrect. (Vide verse 14.)

(4) B reads पादामोदसु, which is unintelligible.

(5) A reads नवा.

(6) Both A and B read एतद्, which destroys the metre.

संस्कारे: सुखूता सर्वेः^१ सर्वेऽसिद्धिकरो चृता ।
 नानासुवर्णकार्येषु रूप्यकार्येषु संयुता ॥ २३ ॥
 धातुधीता च याः धातुः सुधामायः सुसंस्कृता ।
 कार्यसिद्धिकरो चेष्टा ज्येष्ठकार्यविधायिका^२ ॥ २४ ॥
 सर्ववाय सुवामाय^३ चासचहृष्पचाहकः (?) ।
 पाचयेत् ग्रासमात्रेण पाचयेदशमं^४ लियम् ॥ २५ ॥
 स्वकौया शनसंदक्षे^५ जाते भवति सिद्धिदा ।
 अन्यथा नेव सिद्धिन्ति जायते मृग-अन्धवत् ॥ २६ ॥

(1) A and B want रुव्वेः, thus rendering the foot incomplete.

(2) A and B read ई, which is not correct.

(3) सर्वेऽसिद्धिकरा is the variant in A and B.

(4) A and B read विधायिका, which is grammatically incorrect.

(5) A has an incomplete foot सर्वतीव्या. B also has रुव्वी रेतुवा.

(6) A reads पाचयेत् शन. B reads पाचयेत् शन्. Both of them seem to be incorrect.

(7) B reads रुव्वेषे.

ताचात्मेनैव यद्गेन चुचामायः 'सुसंख्लिः ।
 यथोक्तसंख्लियुता' सर्वंतो धातुरुक्तमा' ॥ २७ ॥
 क्रियोचितसुसंख्लाराम्' कारयेद्यज्ञतः सदा ।
 यथोदितेसु संख्लारैर्यज्ञा कार्यकरो सदा ॥ २८ ॥
 सर्वसच्चसंयुक्ता धातुष्ठौता सदैव हि ।
 जायते नैव सन्देहः कार्यकारणकारिका' ॥ २९ ॥
 पात्रस्य वाच ।
 क्रियत् परिमिता धातुः संस्था वदतु मे विभी ।
 उत्पत्तिर्लक्षणं तेषां स्तानं चेव पूर्वक् पूर्वक् ॥ ३० ॥

(1) A reads सुचामाय. B reads चुचामाय. Both are unintelligible.

(2) Both A and B read उंग्गर, which mars the metre.

(3) सुर्वे नै धातुरुक्तमा:, a variant in A and B, which is grammatically incorrect.

(4) A and B read only इक्षारा, which is incorrect.

(5) Both A and B read कारणः, which seems to be incorrect.

(6) B reads स्तानं तेषाः.

कथतां देवदेवेण सप्तसत्त्वसंस्कृतिः ।
भेदोऽभेदोऽय॑ योगव मारचं चारचं तथा ॥ १ ॥

पातमं द्रावणं चैव बोटमं जारचं तथा ।
सारचं जोवनं वस्तुं गोपनं सेपनं पुनः^२ ॥ २ ॥
जातिभेदः सुगम्भव मेषनं वरचं परम् ।
समचं कथतां देव उपचातुकरौ क्रिया ॥ ३ ॥

महादेव उवाच ।

नृषु देवि प्रवक्षामि वातुकानानि सप्तचम् ।
उपचातुरनेका हि^३ तेषां मारचचारचम् ॥ ४ ॥
चचयं राग(?)कारं च शोधनं वस्तुनं तथा ।
मारचादि च यत् प्रोलं तत् सब्दं शूयतां शमे^४ ॥ ५ ॥

(1) भेदाभेदाच is the incorrect reading in A and B.

(2) A reads इतः, which is senseless.

(3) उपचातुरनेकानि, an incorrect variant in A and B.

(4) Both A and B want this word, which may be supposed to be राव or वाव here.

(5) नम् उद्दे उपचानि ते, a variant in A.

पार्वत्यवाच ।

प्रथमं वट देवेश धातुनुक्रमकाचारम् ।

प्रस्तेकस्थानकपं हि गुणसम्बन्धकारकम् ॥ १६ ॥

महादेव सवाच ।

शृणु टंवि प्रथमेन सिंहास्तवचनं मम ।

येन विज्ञानमावेण जायते धातुक्षतक्रिया ॥ १७ ॥

प्रथमे धातुनामानि संखेपात् कार्यकारणम् ।

कथयामि च ते भट्टे पश्चात् स्थानस्त्र संपदः^१ ॥ १८ ॥

पाढो सुवर्णनामानि संखेपात् शृचुतां प्रिये ।

स्त्रयं सुवर्णं सूख्यं च इटकं वड्डिरोचनम् ॥ १९ ॥

सु(स) रङ्गं च तथा स्तोहं देवधातुमीनोहरम् ।

वेद्यो^२ विज्ञासगं चैव घर्माटं स्त्रियिदेवता ॥ २० ॥

जौवनम् अमृतं चैव हेम^३ हिमवतोहरम्^४ ।

देववल्लभगं टिक्कं संसारोत्तारणं महत् ॥ २१ ॥

(1) Both A and B read संपदि, which has no sense.

(2) A reads पाढो.

(3) उेन is generally used

(4) हिमवदुहरं is the correct term.

शौवनं सर्वलोकानां^१ नारीषा रस्तम् शुभम् ।
 अन्यानि विविधनामानि^२ गोप्यगोप्यतरादि च^३ ॥ ४२ ॥
 रजतं च तथा रुद्रं चन्द्रयन्द्रस्य दीपकम् ।
 शुभच्छोतिःकर्त^४ सुर्योदवीजं तारकं तथा ॥ ४३ ॥
 परमा वस्ते तेव^५ कथा उद्दिकरात् ये ।
 स्वापितं लौकिकं चेष्ट^६ येनासन्वसन्नुहनम् ॥ ४४ ॥
 शौतवीये लतुवीये विवश्च वासनाशनम् ।
 रसुच्छोकरं त्रौदं धातुपुच्छनकारकम् ॥ ४५ ॥

(1) The first term in the previous verse is only 'शौवन'. But here it is 'सर्वलोकशौवन'. Hence there is no repetition.

(2) अन्यानि विविधात् नामान्, an incorrect variant in A and B.

(3) शौतवीयतरादि च is the reading in A and B, which has no clear sense.

(4) A and B read शुभवीयतरादि, which is incorrect.

(5) A reads लौकिका देषा, which leaves out चेष्ट.

रतिटं बहुवीर्यं च शुभधाम च संचयम् ।
 एतानि रजतनामानि शताव्यन्धानि सुन्ति वै ॥४५॥
 ताम्रं च लुम्बकाधिष्ठं शुखं नागस्य मर्हनम् ।
 नीलविसूमं वर्मनं चैव पातकम् ॥ ४६ ॥
 उच्चम् उच्चकरं सिंहं छक्षयं कालमर्हनम् ।
 हेमगम्भीं च कामोटं विषटं विवनायनम् ॥ ४७ ॥
 आरस्तु सहायतः मध्यादी मार एव च ।
 एतानि शुखनामानि अन्धानि विविधानि च ॥४८॥
 बासुत्वं च जारातीतं राजतं यशदायकम् ।
 रुप्यभाता वरीयुष्म व्रोटकं कोमलं सघु ॥ ५० ॥

(1) A has शताव्यानि वर्तते. B has रजतनानि वर्तते. Both the readings are grammatically incorrect.

(2) वै is dropped in A and B.

(3) The sense of नीलविसूमं seems to be नीलविसूमं—बीजद्वयम्. A reads चर्मनं, which is incorrect.

(4) A reads हेमगम्भे.

(5) A and B read सहारं च.

चर्मकं सुर्यं चैव रसकं रसवर्द्धकम् ।
 सदापव्यं बलोपेतं पौत्रागं सुभक्ष्यकम् ॥ ५१ ॥
 एतम् सुर्यरनाम कार्यकर्मसु सिद्धिम् ।
 रसराजार्दकं कर्म्म' छतं सिद्धिषु जायते ॥ ५२ ॥
 वपुस्तापहं वहुं रजतारिक्षं नोरदम् ।
 - श्रीतवौव्यकरं श्रीदं रतिदं तापहारकम् ॥ ५३ ॥

(1) रसचार्दक, the reading in A and B, is not grammatically correct.

(2) शते is the reading in A and B; which is incorrect.

(3) Both A and B read वार्द्धक्षेत्रं विहितान्, which is grammatically incorrect.

(4) रसराजार्दकान् वार्द्धान्, an incorrect variant in A and B.

(5) A reads शते विहितु. B reads शते विहितु. Both are incorrect.

(6) Both A and B read रजतारिक्षं च, which is senseless here.

मिहङ्गं माहसाद(?)भूतं सहायं धातुशेषयोः ।
 एतानि व्रपुमामानि सुसिंहं कार्यकारकम् ॥५४॥
 मीसकं धातुभङ्गं च मृतकं रोचकं परम् ।
 रक्तं च रक्तवीर्यं च रक्तवस्तुविवर्णनम् ॥५५॥
 अन्तर्घयं च गश्चौरं धातुभस्त्रनकारकम् ।
 याहकं रसराजेन अक्षोभ्याक्षोभतं परम् ॥५६॥
 विचित्रं विनतं चैव नानारक्तप्रटायकम् ।
 नागं नगातर्यं प्रोलं मिहकं कण्ठशोधनम् ॥५७॥
 दण्डं धण्डकरं चैव दुरितं धण्डकारकम् ।
 एतानि¹ नागनामानि कार्यकाले प्रयोजयेत् ॥५८॥
 मोहं च आयसं शूरं सूर्यकम्पिण्यारटम् ।
 इत्यकं खननं अर्चमारकं ताटकं मलम् ॥५९॥

- (1) सुविदे कार्यकारकम्, an incorrect variant in A and B.
- (2) A and B read शौष्ठवं.
- (3) B has only रक्तं दीर्घं च, which is incomplete.
- (4) A reads रक्तं च रक्तवीर्यं चैव.
- (5) A and B read एकसे, which is incorrect.
- (6) A has सखे पारकं. B has सखे नारकं

अजरं च जरायुक्तं धात्वाद्यम् अवनौचुतम् ।
 कालेयं औषधं कालं इधिरं रोगनाशनम् ॥ ४० ॥
 ग्रन्थिदं सर्वधातुनाम् अच्छोभ्यं खलवडियु ।
 वडियं वडिवौजं च सर्वधातुसहायकम् ॥ ४१ ॥
 एतानि सोहनामानि ज्ञात्वा कर्माणि कारयेत् ।
 जायते^१ सख्ला सिद्धिर्वियोगयोगसंयुता^२ ॥ ४२ ॥
 नामानि धातसंयोगे ज्ञातानि तानि च शुचु^३ ।
 शुखस्तुपरसंयोगे जायते पित्तलं शुभम् ॥ ४३ ॥
 पित्तलं चैव नारीकं बफटं गन्धदुर्बल्यम् ।
 वर्षदं दुर्बलं चैव राजतं वज्रभं सघु ॥ ४४ ॥
 वज्रताम्रसंयोगेन जायते तेन^४ कांस्यकम् ।
 कांस्यकं कोमलं चैव नैरसं रसकाठिनम्^५ ॥ ४५ ॥

(1) A reads जीवते.

(2) विदीकाशीव is the variant in A. विदीकाशीव is the variant in B. Both the readings seem to be incorrect.

(3) ज्ञातानि च ते शुच, an incomplete variant in A and B.

(4) A has जातेव. B has जायते तेवैव.

(5) A and B read erroneously उठिव.

तौद्रनाटं महायद्म^१ उपकाक्षि रविप्रदम् ।
 व्याप्तापिधाने रोट्रं च पाहकं^२ धूम्रोधनम् ॥ १६ ॥
 एतानि^३ कांस्यनामानि कार्यकाले प्रयोजयेत् ।
 दश्मने धारणे चैव मुद्रणे धूम्रवन्धने ॥ १७ ॥
 अपर्दैः सह पारदं^४ दिव्यं^५ किञ्चित् प्रलेखयेत् ।
 जायते रसको नाम नामारोगहरो भवेत् ॥ १८ ॥
 नागसु रहते^६ होनो मृतधातुसु जायते ।
 स एव कोमलामित्तः^७ सिन्धूरं जायते ध्रुवम् ॥ १९ ॥

- (1) A reads महायद्म. B reads महायद्म. Both the readings are incorrect.
- (2) A reads पाहकं, which has no clear sense.
- (3) And B read एतानि, which is incorrect.
- (4) पारदी दिव्यी is the reading in A and B, which is incorrect.
- (5) B reads रहते, which is not correct.
- (6) कोमलापित्ते is the reading in A and B, which is not correct.

अनेकाः^१ साधयेद्विद्या मन्त्रयम्बकरीः क्रियाः ।
 पूजनार्थं मम गुणाः सर्वे कस्तितरोचनाः^२ । ३० ॥
 ताम्बदाहजलैर्योगे जायते तुत्यकं शुभम् ।
 नामा रसायनी विद्या साधयेत् सा^३ सदैव हि ॥ ३१ ॥
 रसरसक(?) योगेषु राजमर्यादा जायते ।
 राजकं जायते नाम नारी राजकसागतिः^४ ॥ ३२ ॥
 संयोगे साधनं दिव्यं वियोगे साधनं शुभम् ।
 वियोगं पुनर्नैर्योगं रसताम्बे शुभो विधिः^५ ॥ ३३ ॥

(1) A reads एवेका. B reads एतेका. Both are incorrect.

(2) A and B read कस्तितरोचनः.

(3) चन्द्र is not found in A and B.

(4) A and B read रसारसकोयेषु, which is incomplete.

(5) नाराराजकसागतिः, a variant in A. नाराजकसागतिः, a variant in B. Both the readings seem to be incorrect.

(6) A and B read उमधिः.

अनेका साधनी विद्या साधयेऽव्यक्ताहितम् ।
 सभते रसायनी विद्या स्वरूपिषि विज्ञातोच्चनी ॥०४॥
 अनेनेव प्रकारेण ज्ञायते नाम कर्मभिः ।
 नामकर्मज्ञता॑ जाते चित्ते निष्पंसता॑ भवेत् ॥०५॥
 एतत्ते कथिता धातोदपधातोस्तु तां॑ शृणु ।
 येन विज्ञानमात्रेण कासकास्या॑ न सिष्टते ॥०६॥
 उपवातोलु मध्येयु श्रेष्ठा माता रसायनी ।
 तस्या नामानि वज्ञामि पवात् स्वानगुणानपि॑ ॥०७॥

(1) A reads इव्यक्ताहितः. B reads इव्यक्ताहितः.

(2) A and B read नामकर्मज्ञता॑, which is unintelligible.

(3) A and B read निष्पंसा, which is not grammatically correct.

(4) A and B read ते, which is incorrect.

(5) A reads कासकास्य. B reads कासकास्य. Both the readings are incorrect.

(6) Both A and B read शृणामि च, which is incorrect.

हरितालं विसङ्गा च रङ्गदीमिकरौ सदा ।
 ताम्तं च हरिता हंसी श्वेतपौत्रविष्णविनौ ॥ ७८ ॥
 नर्तकस्य प्रिया देशी निशा चैव निशाचरौ ।
 पारदस्य चयकरौ पश्चात्त्वेदकरौ चूता ॥ ७९ ॥
 रोगहा जीविनौ जेवी जरादारिद्रनाशिनौ ।
 एतानि तान्त्रनामानि संख्येपात् कथितानि ते ॥ ८० ॥
 शुल्को ध्रानेन यः^३ कर्त्ता पश्चोभ्यो^४ जायते सदा ।
 अनेनैव प्रकारेण कर्त्ता कर्माचि साधयेत् ॥ ८१ ॥
 मनःशिला शिक्षा शूद्री कुनटी च छातोद्यमा ।
 दरदां भगिनी देशी सिन्दूरस्य सखो सदा ॥ ८२ ॥

(1) The 78th and 79th slokas are not found in A.

(2) संख्ये विष्णविनौ, a variant in A and B, which has no sense.

(3) शुल्कानेन यि, an incorrect variant in A and B.

(4) A reads पश्चोभ्यो, which is incorrect.

(5) B reads शैरा.

पुष्पा पुष्पवती^१ पद्मी शास्त्रिनी रसिनी गुणा ।
 एतत् च शिलानाम^२ कार्यकाले प्रयोगयेत् ॥८३॥
 अभ्रकं चैव व्योम^३ च गगनं याहकं परम् ।
 दुष्टवीर्यच वातस्त वडिनादोषतात्त्वति^४ ॥८४॥
 अजरम् अमरं घोरं घोरपश्चत्वं नाशनम् ।
 रसमूलरसातीतं रसच्चे राज्यवर्द्धनम् ॥८५॥
 अमृतम् अमर^५ चैव महामृत्युविनाशनम् ।
 एतात्यभ्रकनामानि ज्ञात्वा कर्माणि कारयेत् ॥८६॥
 सोमलं महराजं च विषं वातविनाशनम् ।
 शोतवीर्यं वसयन्वि नीक्षटव्यलकारकम् ॥८७॥
 खेदनं भेदनं चैव कामवीर्यविवर्द्धनम् ।
 वस्त्रं सर्वधातूनां मारणं पारदे रसे ॥८८॥

- (1) A reads पुष्पती.
- (2) एतस्त च विला नामान्, an incorrect variant in A and B.
- (3) Generally used as व्योम.
- (4) A reads वडिनादि एतः चकिः, which is incorrect.
- (5) A and B read लंडन, which is incorrect.
- (6) A repetition of the name.

गगनयाहके दिशे रसयुग्मे प्रमेसनम् ।
 एतानि महानामानि काय्यंकाले प्रदोजवैत् ॥८१॥
 होनवातोच नामानि संचेपात् तानि च शुचु ।
 येन विज्ञानमावेष जायते पारदो क्लिया ॥८०॥
 मुक्ता मुक्ताफलं वारि वारिं ज्ञातिसञ्चयम् ।
 शुक्लिगम्भे च सगर शुक्लार्द भृत्योदयम् ॥८१॥
 तेजसम् अमृतोद्रुतं श्रीतलं श्रिसौमं भनः ।
 ऋयश्च वं कलं द्वौपं स्त्रिय सौभाष्यदायकम् ॥८२॥
 रतिराजपहः श्रीभाकामसन्दीपनं तथा ।
 मुक्तानामानि रम्यादि ज्ञात्वा कर्मादि कारयेत् ॥८३॥

- (1) A reads वने शुचु, which is incorrect.
- (2) B reads शुक्लिगम्भे, which is not correct.
- (3) B reads हं शुचु, which is incorrect,
- (4) B reads भनः, which is not correct.
- (5) श्रीं श्रीभाष्यदायिने, an incorrect variant in A and B.
- (6) A and B read हि रम्याद्, which is incorrect.

विदुमं वरदं वेसावङ्गीवातं प्रदासनम् ।
 नौरसम्^१ अधरेसीमा शिखरं शिखरोङ्गवम् ॥ ८४ ॥
 वर्णदं विवरं चैव चेष्टये^३ च विभूयशम् ।
 विदुमस्येतामानि^४ कार्यकाले प्रयोगयेत् ॥ ८५ ॥
 चर्मकं कूर्माकं चैव वमठपृष्ठं सकालकम् ।
 वमठं कर्कशं चैव कलिङ्गजातं माशमम् ॥ ८६ ॥
 कचकं कदहुः^५ कर्म लोके काचकटं तथा ।
 एतानि कूर्मपृष्ठस्य नामानि च विशेषतः ॥ ८७ ॥
 शङ्खं च अस्त्रं चैव देववादिवभिव च ।
 विष्णुवङ्गभक्तं चैव सोमदेवतकं शमम् ॥ ८८ ॥

- (1) A reads विदुमि वरदं. B reads विदुमि वरदे.
- (2) A reads नौरसि.
- (3) A and B read चार्षेष्ट.
- (4) A has विदुमेवानि. B has विदुमीवानि. Both are incorrect.
- (5) विंशताशम् is an incomplete variant in A and B.
- (6) A has वमठकहुः. B has वमठपृष्ठः.
- (7) B reads erroneously विष्णुवङ्गमान्तः.

वरायुधं च वरदं शुभं माङ्गल्यदायकम् ।
 अजेयं सर्वजन्मतुमां दानवात्मि वरोदयम् ॥६८ ॥
 गच्छीरं वोषगच्छं च पवित्रं पारदं महम् ।
 एतानि^१ शंखनामानि वामदक्षिणावृभौ ॥१००॥
 शुलिका भौफिका^२ काल्पी मुक्तामाता गरीयस्ती ।
 चन्द्रपद्मी पथोषाही संपुटी पटबादिनी ॥१०१॥
 रजताभासिनी दीप्ता वङ्गवारिविशेषणी ।
 पश्चकरोगतिः पश्चगर्भं समुद्रसम्भवा ॥१०२॥
 उत्तमा भृष्मा भीषा विविधा सागरोद्धवा ।
 नव्युद्धवा तु सा नोचा^३ नोचकर्मविश्वारदा ॥१०३॥

(1) Both A and B read वर ईद, which destroys both grammar and metre.

(2) A and B read एताने, which is grammatically incorrect.

(3) A reads वामदक्षिणावृभौ. B reads वामदक्षिणावृभौ.

(4) B has only शीषा.

(5) A and B read पश्चगर्भ

(6) नव्यीद्धवा नवीषा, an incomplete variant in A.
नवीद्धवा नवीषा, an incorrect and incomplete variant in B.

एतम् लक्षणं श्वलेः^१ कर्मकाले प्रयोजयेत् ।

आत्मा यः कुरुते कर्म सिद्धयेत् सकलं फलम् ॥ १०४ ॥

ग्रीष्मव रटं दक्षं छिं चैव तु पुष्पकम् ।

नारीसौभाष्यदं चैव गजभूषणसन्ध्यान् ॥ १०५ ॥

तैकरचाकरं श्रीदं संपुटं पुष्टिकं तथा ।

नामानि गजदक्षस्य अव्यानि मध्यमानि च^२ ॥ १०६ ॥

पिञ्जकं कुकूठं च च शिखिपिञ्जं सुचित्रकम् ।

हरिमौलिधरं श्रीदं मोहनं चक्रकं तथा ॥ १०७ ॥

नागारिं मर्यदमनं विषटं विष्वाशनम् ।

एतानि शिखिपिञ्जस्य नामानि विविधानि च

॥ १०८ ॥

(1) A and B read एतते लक्षणा इति, which is an incorrect variant.

(2) कर्मकाले श्रीदेवे, a variant in A, which seems to be incorrect.

(3) A reads वरद, which is incorrect.

(4) लक्षणे वज्राणि च, a variant in A and B, which is grammatically incorrect.

नसं चहृदयपुरं धातुकोमलकारचम् ।
 यज्^३ दुर्गम्भिकं चैव तुरीटापसु ओभकम् ॥१०८॥
 कचं केशं च वासं च मूर्हजालकमेव च ।
 श्वामं चैव घने प्रोक्षं कर्णशं नर्मदं सघु ॥ ११० ॥
 एतानि धातुनामानि यथाकर्माभिधानकम् ।
 शास्त्रा चारभ्यते कर्म अस्ते सिद्धिः प्रवायते ॥१११॥
 पार्वत्युवाच ।
 शशो शहर विश्वेष विश्वनाथ जगद्गुरो ।
 चुतानि चैव नामानि शास्त्रानि कर्मकां प्रमो ॥११२॥

(1) ए उदयपुर, a variant in A- ए उदयपुर, a variant in B. Both are incorrect.

(2) B reads चारच.

(3) B reads यज्, which is not correct.

(4) A reads तुरीटापहृकोभकम्.

(5) A and B read अस्ती, which is grammatically incorrect.

महादेव उवाच ।

श्रुणु देवि प्रयत्नेन स्वामानि विविधानि च ।

सुवर्णस्त्रोदयो धातोः सर्वव्यापकपर्वते ॥ ११३ ॥

पार्थिंश्च हि च तत् सर्वं नृदानव्यात् प्रजायते ।

तत्त्वात् स्वामस्व मन्त्रेषः श्रवता सादरं शुभे ॥ ११४ ॥

हेमं च प्रथमं कल्पं मेहमध्ये सदैव हि ।

दुर्गंभं भस्यतोकेषु कष्टेनैव तु सम्भवते ॥ ११५ ॥

पुनर्हेमाद्रिषा तेन जायते सर्वदा शुभे ।

महाश्योतस्तते ॥ तेन दुर्गंभं स्वात् सदैव हि ॥ ११६ ॥

पश्चात्प्रस्त्रदोहृतं जम्बूहोपेषु जायते ।

तत् कष्टतरं मन्त्रे दुर्गंभं तत् सदैव हि ॥ ११७ ॥

(1) A reads वचीक. B reads वचाक. Both the readings are incorrect.

(2) पार्थिव्यानि च ते चर्वे, an incorrect variant in A and B.

(3) A and B read शादरात् which is incorrect.

(4) A reads वस्त्रसोतस्त्रै, which is incorrect.

(5) B reads उदैव हि, which is incorrect.

पृथिव्या धातुमधेषु सर्वेषामधिकं सदा ।
 लोहाधिकतरं तत्र ज्ञातश्यं सर्वदा शुभे ॥ ११८ ॥
 कष्टे जिः मारणं तेषां लोहादधिकं जायते ।
 तस्मात्सेनेव यद्देन साधनं क्रियते नरैः ॥ ११९ ॥
 असाध्यसाधनं तस्य जातं सर्वयुगे शुभे ।
 तस्मात्^३ यहुमूल्येन सर्वधातूपरिस्थितिः^३ ॥ १२० ॥
 पुनः स्थानं छतं तेन लक्ष्यार्थं च सदैव हि ।
 उद्दितं तेन यद्देन मर्त्तादृभौतं मया शुभे ॥ १२१ ॥
 पावर्णस्युवाच ।
 महारद्व शङ्कर औमन्^४ लोकनाथ बगतृपते ।
 कथं ते मानुषे भौतिः^५ कथतां परमेश्वर ॥ १२२ ॥

(1) A has शुभते नरा. B has शुभते नरा. Both are incorrect.

(2) A and B read तस्माते, which is incorrect.

(3) वर्षातोपरिस्थिति, an incorrect variant in A and B.

(4) A and B read erroneously चक्षाह.

(5) लोकार्थ, a reading in A and B, is not correct.

(6) नामुषाद्भौतिः is the correct form.

महादेव उवाच ।

सुवर्णस्यैषा महतो^१ भीतिर्मात्रुप्रसन्नवा ।
उच्चो नीचपदं सम्यक् जायते वहुले रतिः ॥ १२३ ॥

अया मानुषभीतिन^२ उहितं सादरेष च ।
दुङ्गेभं च विशेषेण प्राक् कलियुगे इदम^३ ॥ १२४ ॥

पात्रत्युवाच ।

मदीये मानसे नाथ जातोऽसौ संशयो महान् ।
अवतां मानुषो भीति कथं तु जगदौशर^४ ॥ १२५ ॥

महादेव उवाच ।

कारवं वस्तंते देवि अव्याहयेयं सुदेव हि ।
कष्टनीयं त्वयि भद्रे यतस्य^५ मम वक्त्रमा ॥ १२६ ॥

(1) A and B read शुर्वर्णस्यैषा महान्, which is not correct.

(2) एवं च भाष्यभीतिन्, an incorrect variant in A and B.

(3) A and B read उमि. This foot is incomplete.

(4) A reads उहं ते वक्त्रोऽशर. B reads उहं ते वक्त्रोऽशर. Both are incorrect.

(5) वक्त्रेभं is an incorrect variant in A and B.

तुष्टिचतुरताभिर्जायते च कस्तौ युगे ।
 मानुषे च भवतीह^१ मम शोभानुवर्त्तिनौ ॥ १२७ ॥
 तथा सैर्वतुल्ये^२ द्रव्ये साक्षते गन्धकी क्षिया ।
 अथवा पारदी चेव मम शोभानुवर्त्तिनौ ॥ १२८ ॥

पार्वत्युवाच ।

श्रुता सा गन्धकी विद्या सर्वसौभाग्यदायिनी ।
 सङ्गभक्षणता मा च^३ न सिध्यति गरीयसी ॥ १२९ ॥
 भवता पूर्वमुक्तं हि सङ्गभक्षणयोगतः ।
 न सिध्यति च ते विद्या मदा गन्धकपारदी ॥ १३० ॥
 तथा तु वास्तवां देव ममोऽकानिविवर्तितम् ।
 सुवर्णसाधिनौ विद्या^४ तथादृद्वदतु मे विमो ॥ १३१ ॥

- (1) A and B read जर्हीह, which is not correct.
- (2) A and B read तथाचे, which is incorrect.
- (3) A and B read मे च.
- (4) A reads नम.
- (5) A and B read सुर्वंसाधिनी विद्या.

महादेव उवाच ।

मानसं मदोर्य देवि जातं सम्यक् सुनिर्मलम् ।
तथापि मानुषे भोतिर्विद्या^१ गम्भकपारदी ॥१२॥
सङ्क्रमत्वात् कष्टम्^२ उभे मेलापनं महत् ।
सुषु पम्बहाते वज्रौ ज्वलते तत्त्वात् ततः ॥१३॥
मम्बवत् नावयेदविद्यां साधयेद्यज्ञातः क्रमात् ।
तथात्मैव महता गोप्या सिद्धिकरी क्रिया ॥१४॥

पार्वत्युवाच ।

पुरा प्रोक्षं त्वया नाथ पट्टे पच्छदग्धके^३ ।
कैलासात् परमं सौख्यं भजते मम्बविल्लगः ॥१५॥
क्रिया गम्भकिनौ^४ मध्ये पथवा पारदी शुभे ।
कैलासादविकं सौख्यं भुजते विधिवक्तराः^५ ॥१६॥

- (1) A and B read विद्ये, which is senseless.
- (2) A and B have वाहू, which is incorrect.
- (3) पट्टे पंचादिके, a variant in A and B, which is incomplete.
- (4) A and B read वंशिणा.
- (5) A and B read वर, which is incorrect.

महादेव उवाच ।

निर्मलं मानसं जातं तत्र वाक्यविमोहितम् ।

कथयामास ते भद्रे गुणसंख्यासंयुतम् । ११० ।

स्वर्णोत्पत्तिसाक्षः नित्यं सर्वचापि विधीयते ।

उत्पादनगतिसाक्ष खाने स्वाने पृथक् पृथक् । १११ ।

श्रयतां वरदे देवि स्वानं चैव ववोदितम् ।

तस्य वातोत्थाना रेक्षधर्मने स्वर्णः आयते । ११२ ।

पावकादेभुवावाहुः¹ सप्तरक्षाकरे तथा ।

समुद्रस्य तटे दिव्ये स्वानं स्वात् स्वर्णकस्य च । १४० ।

स्वर्णं च सिमुदेश्येन कामकृपेस्तथैव च ।

अन्यैस्तु विविधे: स्वानैः साम्रातोत्पत्तिर्जायते । १४१ ।

(1) A and B read शुभः, which is not accurate.

(2) Both A and B read स्वर्णोत्पत्तिः शर्व, which is not correct.

(3) A and B add च after शर्वे.

(4) A reads पावकादेभुवावाहुः. B reads पावकादेभुवावाहुः.

तत्त्वं तचोत्पत्तिस्त्रेषां यद्ग्र यद्ग्र हिमद्रवः ।
 प्रसरन्ति भूवि संघाः¹ संशयो नास्ति ते सदा ॥१४२॥
 तान्बोत्पत्तिर्व महता सुखेनैव प्रजायते ।
 तेषां स्वानानि वस्त्रेऽप्त² याथात्येन च शृणु³ ॥१४३॥
 नेषाले कामरूपे च⁴ वक्तुले नदनीवर्ण⁵ ।
 गङ्गाद्वारे मल्लाद्रौ च व्याघ्रदेशे तथैव च ॥ १४४ ॥
 पावकाद्रौ जीर्णदुर्गं रूपदेशे फिरङ्गके ।
 एतान्दुषितस्वानानि⁶ सर्वपर्वतके⁷ सदा ॥ १४५ ॥
 बासत्वं यसु⁸ दिव्यं हि स्वानानि तत्त्वं च शृणु ।
 कुम्भाद्रावय⁹ कामोले रूपदेशे वसत्यति ॥ १४६ ॥

- (1) वक्तुले is the variant in A. वक्तु is the variant in B.
- (2) स्वानान् प्रवस्त्रेऽप्त is the incorrect variant in A and B.
- (3) A and B read नदनीवर्ण.
- (4) नेषाले कामरूपं च, a reading in A and B.
- (5) वक्तुले नदनीवर्ण, a variant in A and B.
- (6) एतानि उदितस्वानानि, an incorrect variant in A.
- (7) A and B read उपर्वतये, which is incorrect.
- (8) A and B read इसे.
- (9) A and B read गुम्भाद्रावय, which is incorrect.

एताभ्युभयोः स्वानानि॑ रजःस्वामं च॒ उच्चते ।
 जासत्त्वं वह्न्ये नागं नेषात्ते च सदेव हि ॥ १४७ ॥
 केदारे वर्णकाण्डे च वरम्बके विपुरे तथा ।
 एतत्स्वानानि॑ दिव्यानि॑ गोप्याभ्युभयानि॑
 तानि॑ ह॑ ॥ १४८ ॥

सोहाद्रौ॑ सोहस्रात् वर्णं मयाद्रौ॑ गौतमाद्रिके॑ ।
 विभगमध्ये॑ हि मर्वं च नसाद्रौ॑ निष्कलेऽपि वा
 ॥ १४९ ॥

(1) एति उच्चते॑ स्वानान्. a reading in A. एति उच्चते॑
 स्वानान्, a reading in B.

(2) A and B read रजस्वानानि॑.

(3) A and B read स्वानवाम् दिव्यान्.

(4) चन्दा वीषा विमीति च, a variant in A and B, which
 is senseless.

(5) A and B read सोहाद्रौ॑, which is incorrect.

(6) Do. Do. वराद्रौ॑, Do.

(7) Do. Do. गौतमाद्रिके॑, Do.

(8) Do. Do. वरम्बके॑, Do.

(9) Do. Do. वराद्रौ॑, Do.

व्रद्धके विमले^१ चैव सौहाकशास्त्रिवाहने ।
 समुद्रस्य तटे रम्ये पाष्ठो अन्ते च मध्यगी ॥ १५० ॥
 लोहस्यैतानि लानानि^२ हाटकैष^३ सदैव हि ।
 किञ्चित्^४ गोप्यानि दिव्यानि संखारैः रहितानि च^५
 ॥ १५१ ॥

युजे तु संखाते तेषु स्थर्णीं सिद्धिः प्रजायते ।
 अयुजे नैव सभ्या तु^६ युजे प्राप्तिः सदैव हि ॥ १५२ ॥
 पारदे गन्धके धात्वोः योग शौषधस्तु^७ सदा ।
 मानसे निर्मले चैव सम्भवते^८ हाटकी क्रिया ॥ १५३ ॥

- (1) A reads शिर्षि.
- (2) शोहस्यैतानि च लानानि, a variant in A and B, which is incorrect.
- (3) A reads हाटकै च.
- (4) केञ्चित् is the reading in A and B, which is incorrect.
- (5) A reads ते. B reads ते.
- (6) A and B read सम्भते, which is not correct.
- (7) Do. Do. शौषधस्तु, Do.
- (8) Do. Do. सम्भते, Do.

अव्यया नैव सम्या तु विना मन्त्रे च सिद्धति ।
 तस्मादेव प्रयत्नेन निर्मालं मानसं शुभम् ॥ १५४ ॥
 अशुभं समसं चैव मानसं सर्वदा भवेत् ।
 तस्मात् चतुराहारे सर्वदा शुभमानसः ॥ १५५ ॥
 आयते च क्रिया सिद्धा हाटको मन्त्रति सर्वदा ।
 मन्त्रसिद्धिः प्रजायेत सर्वकार्म्माणि साधयीत् ॥ १५६ ॥
 अनेनैव प्रकारेण उत्तमा हाटको क्रिया ।
 सर्वकार्म्मकरी नृषां चतुर्वर्गफलप्रदा ॥ १५७ ॥

महादेव उवाच ।

प्रोक्षसंपुटके चैव स्तु सकाचीयकेन च ।
 उच्छाङ्गाराजते अम्बोऽ सुर्मुरं छागरिकजन् ॥ ८ ॥

- (1) A and B read सर्वते, which is not correct.
- (2) A and B read तस्मादेव, which is not correct.
- (3) A reads चतुराहारे, which is unintelligible.
- (4) A reads हाटिरक्षि. B reads चतुराहि.

चर्पदात्मे पुटे चेव चारस्त्रोत्पलकेन च ।
 साहं विनालिः (?)गति च व्यक्तिं पर्वमर्दगे ॥ १० ॥
 एवानुक्रमतो योगे पुटमेकं च आयते ।
 चतुर्थेन जासत्वं सुवर्णाहापयेत् सुधीः ॥ ११ ॥
 प्रति संपुटपुटे चेव उडयेत् कुचक्षर्परे ।
 ज्ञानशोतः समुदत्त्वं सेपमुत्तारयेत्ततः ॥ १२ ॥
 पुनरेव घोटनं देयं सादरं पुनरेव हि ॥ १३ ॥
 अनेनैव प्रकारेण तुम्हांशसंपुटेन हि ।
 सुवर्णसंबृतं तथा गालयेत् चारसंसुतम् ॥ १४ ॥
 व्यक्तिं तोहयत्वेव तिलाहं संपुटं प्रति ।
 गर्भीभूतं च रहयं संज्ञारेः शुद्धं साम्प्रतम् ॥ १५ ॥

- (1) A and B read व्यक्तिरहर्वर्द्धका.
- (2) जावधीतेन is the reading in A and B, which is not accurate.
- (3) A and B read सेपमुत्तारण ततः, which is incorrect.
- (4) A and B read पुनरेव व्यात्मा, which is not correct.
- (5) A and B read हि च, which is incorrect.

एतदृक्मकामेषैव सुवर्णमनुसंचय ।
 तदगुणे शोषिमावौते महतः प्रायते ॥ १६ ॥
 आरक्षं पौतमनुमत्तं जायते हाटकं महत् ।
 हाटकं मत्तकं चैव न च हीनेन योजयेत् ॥ १७ ॥
 कलागुणगते हृष्टिर्यायते उत्तमे नरे ।
 अनेनैव प्रकारेण मादाहिगुणं दापयेत् ॥ १८ ॥
 कलावयमिति हृष्टिर्यायिता हृष्टिरिष्टते ।
 निर्हीवं जायते दिशं दशसंपत्तिदावक्त्वा ॥ १९ ॥

पार्वत्सुवाच ।
 अधिकेन स्तूते तद्व शोषणाने सुशोभने ।
 जायते कोहृष्टं देव संयोगे अधिके सति ॥ २० ॥

- (1) A and B read हृष्टिर्याय, which is not correct.
- (2) A and B read हाटके नवदै चैव.
- (3) उत्तमो नरः, a variant in A and B.
- (4) A and B have कलावयं.
- (5) A and B have से च, which is incorrect.

महादेव उवाच ।

शोषणं च संयोगे भङ्गदः परस्ति^१ निश्चयः ।
 हिंगुच्छोषणमेन कल्पकं जायतेऽशुभम्^२ ॥ २१ ॥
 वेघसुंगं सुधनायै क्रिंशये दिक्पलोपमम् ।
 अतिरिक्तद्वयं तद्वयं जायते सुगुणं महत् ॥ २२ ॥
 गालयद्यज्ञपूर्वेच क्षायेद्रससमांशके ।
 समांशे गम्भकं देयं शुद्धं पीतकरागकम् ॥ २३ ॥
 चयतुखांशकं तासं दापयेद्रसमोदितम् ।
 तदैव सादरं देयं मर्हयेत् कथकारसे ॥ २४ ॥
 वामद्वितयमामाहंग^३ क्षायाश्वकमच्छेत् रसे ।
 अतिशुख्तेरे उद्गते पदवा सोहसंभवे ॥ २५ ॥

(1) A and B read वंशदा चाच, which is incorrect.
 (2) Do. हिंगुच्छ.
 (3) Do. शुद्ध, which appears to be incorrect.
 (4) Do. पीतक, which is senseless
 (5) वामद्वितयमामाहय, an incomplete variant in A and B.

मर्हयेदयन्नपूर्वे च जायाशोषितं कारयेत् ।
 काचकूप्ये प्रदातव्यं¹ वज्ञिर्वालुकयन्नगः² ॥ २६ ॥
 नखसंख्यामिते यामि पाचयेदसं शोभने ।
 स्वाक्ष्योते तु संजाते पुनः खले निधापयेत् ॥ २७ ॥
 रसेनानेन आमहं जायाशोषितं कारयेत् ।
 उत्तयामि रसे³ दत्ते पुनः शोषं⁴ प्रदापयेत् ॥ २८ ॥
 उत्ताम्बो दापयत्येत् पुनः संखारमाचरेत् ।
 संस्कारे विविधे जाते अम्लपूर्वे क्रमोदिते ॥ २९ ॥
 जायते रसराजोऽसौ सब्दं सामर्थ्यदायकः ।
 संचयेत्तक्तुलार्चसु अतिविक्रमवेगवान् ॥ ३० ॥
 जायते प्रबला तुष्टिः विदिने सेवते यदि⁵ ।
 सार्वद्विक्षमिनेव दिने मासफलं सदा ॥ ३१ ॥

(1) प्रदातव्या, a reading in A and B.

(2) वज्ञिर्वाला, a reading in A and B.

(3) रसी is the variant in A and B.

(4) शोषं is the incorrect reading in A and B.

(5) A and B read उत्तमेष्वपि, which is grammatically incorrect.

जायते नात्र सन्देहः सिद्धिर्गम्भकसम्भवा ।
अनेत्रेव प्रकारेच रससिद्धिः प्रजायते ॥ १२ ॥

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पावर्णत्युवाच ।

स्वेतता कर्मणा केन^१ जायते रजतेषु च ।
क्रमेण राजती सिद्धिः पशाहाटकसम्भवा ॥ १८ ॥

महादेव उवाच ।

भद्रानम्भरता विष्णा धातुसंस्कारकारिष्ठी ।
जासत्येः कठिने जाते शुद्धे कोमलकारिष्ठी ॥ १८ ॥

तथाच पौत्रशुभेषु जायते शुद्धनम्भता ।

शूल यद्वे क्रिया दिष्ट्याः शुद्धजासत्यसम्भवाः ॥ ४० ॥

पिण्डं हयशुरोत्तं च छिगुचं धातुतः सदा ।

घर्वन्तु दाययित् स्त्रावे घर्वे निष्ठे च^३ रजयेत् ॥ ४१ ॥

(1) केन वर्तेष्व, an incorrect variant in A and B.

(2) जासत्त् is the reading in A and B, which is not correct.

(3) A and B read निष्ठेष्व.

निर्मलं धातुलं द्रावं सावचुर्चेन ठालयेत् ।
 यद्वै च लितं निकं तत्कालं दापयेत् सुधोः ॥४२॥
 उपरि संपुटं देयं उक्तुद्रक्षुक्टे पुटे ।
 स्खाङ्गशीतं समुद्रत्वं जायते निर्मलं महत् ॥४३॥
 आसत्वे मोमलं देयम् उक्तभागीनः साम्रातम् ।
 चूर्णान्तरगतं क्षत्वा उक्तव्यं जायते महत् ॥४४॥
 तदेव जासत्वं चेव दिव्यम् उक्तव्यं मदा ।
 कृप्याहं भेदयत्वेव जायते शुद्धता शुभा ॥४५॥
 अनेनैव प्रकारेच धनं विचित्रं जायते ।
 धने चेव तु संज्ञाते वारयेदूर्ध्वाः श्रियाः ॥४६॥

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अतीव शोभना विद्या रमगन्धकाणा सदा ।
 अतिशोभासदा सा च साधके सुखदायिका ॥४७॥

(1) एमुट उड्डाए पटे, a variant in A and B, which seems to be incorrect.

(2) उक्तभीवेष, a variant in A and B.

(3) A and B read च एव, which is not correct.

(4) Do. ते Do.

एताह्यं च जासत्वं शोधितं गम्भकेन च ।
 धानधौतेन ताम्रे च पुच्छितं सुभगं सदा ॥ ६८ ॥
 पुच्छितं जायते दिव्यं एत्यपौत्रं शुभोदितम् ।
 निर्मलं जायते तद्व ईनहाटकसविभम् ॥ ६९ ॥
 सधुता जायते तस्य किञ्चित्कार्या गुरुता सदा ।
 जायते गुरुता दिव्या पुच्छिते हाटकेन च ॥ ७० ॥

२१ घ-पठसादुदृताः शोकाः ।
 पार्वत्युकाच ।
 पूर्वमुहूँ ख्या नाथ धने सिहिसु जायते ।
 सतुद्रवहते धातोः वटः किं तद मुहूते ॥ ४१ ॥
 महादेव रवाच ।
 क्रिया चम्बः शुभा लेषां द्रव्यसिहिविधायिनी ।
 शृणु यद्देन तां भद्रे क्रियां रंगीति नागजाम् ॥ ४४ ॥

- (1) A and B read ग'विति.
- (2) A and B read वाति, which is incorrect.
- (3) A reads वच. B reads वचः.

आनयेत् पारदं दिव्यम् पञ्चत्रूपिणितितम् ।
 आनयेद्यद्यपूर्वेष खले पिष्टं तु कारयेत् ॥ ४५ ॥
 तेसेनानेन आमर्हं भावमां च च मावतः ।
 निष्ठे उमरके यस्ते भ्रमिं टद्याद्विचक्षणः ॥ ४६ ॥
 उत्थयेद्यामयुम्भेन स्वाङ्गशीतं समुचरेत् ।
 पुनः समाननागीन पूर्ववत् आनयेत् सुधोः ॥ ४७ ॥
 पुनरेव इठादन्मौ उत्थयामेन मिष्टगति ।
 रसे दिवारके चेव हीनहेमोत्तमोत्तमः ॥ ४८ ॥
 तौलिके रस्तिकायुम्भं दापिते वर्णपञ्चकम् ।
 अनेनैव प्रकारेण जायते घोड्य कक्षाः ॥ ४९ ॥
 द्रव्यघुष्टिकरं तत्त्वं जायते नावं संशयः ।
 पुनरेव क्रिया रस्या पारदे नागचारिणी ॥ ५० ॥
 हिंगुष्टे चारिते तत्त्वं जायते चन्द्रिका शुभा ।
 आभासेन शिल्पिष्ठोवा जायते नावं संशयः ॥ ५१ ॥

(1) हीनहेमोत्तमः, an incomplete variant in A.

(2) वर्णकः is the reading in A and B, which is incorrect.

(3) तत्त्वं is the incorrect reading in A and B.

पुच्छते हौनहैमेन आयते क्रयविक्रयः ।
 अनेनैव प्रकारेण आयते धनसंपदः ॥ ५२ ॥
 अतऊँ क्रिया या च^१ विद्या नागस्त संभवा ।
 रसे तु नागजे चैव विधिनानेन वर्तते ॥ ५३ ॥
 तायते^२ सक्षाता विद्या नामतैस्त्वा संभवा ।
 सर्वा सा^३ शोभना विद्या तौवदारिद्रग्नाशिनी ॥ ५४ ॥
 अथातः संप्रवर्जामि वपूषां विधिसुत्तमम्^४ ।
 यैन विज्ञानमात्रेण आयते रजतं महत् ॥ ५५ ॥
 अनेका राजतौ सिद्धिः आयते परमोत्तमा ।
 आयते धनसिद्धिः^५ आयते नात्र संशयः ॥ ५६ ॥

- (1) A and B read उ च, which is incorrect.
- (2) A and B have ताते, which is incomplete.
- (3) A and B have शा, which is not correct.
- (4) A and B have विधिसना, which is grammatically incorrect.
- (5) A and B have नात्र instead of च, which is a tautology.

पार्वत्यवाच ।

वद वैभवदातार^१ वहुं विभ्रानदायकम्^२ ।

आत्मा सिद्धिमवाप्नोति गुणाङ्गैः सौख्यकं च यम् ॥५७॥

महादेव उवाच ।

आनयेच्छोभनं वहुं विन्द्याचलचलुङ्घवन् ।

गालयेद्यजपूर्वेण ठासित् छष्टाशुच्छे रसे ॥ ५८ ॥

विःसप्तकाष्टते तथ^३ जायते निर्मलं शुभम् ।

तदुत्थान् कारयेत् पचान्^४ शुचिविदान् यषोदितान्

॥ ५८ ॥

रचयेद्यजपूर्वेण आनयेद्यविर्किं^५ पयः ।

भावयेत् शुक्लकाचूर्चम् उव्वृत्तं वक्त्रियोचितम् ॥५९॥

(1) दावा च, a variant in A and B.

(2) दावकः, a variant in A and B.

(3) ते च is the incorrect variant in A and B.

(4) A and B read उषोदान्, which is incorrect. The word पम् is used here in the masculine gender.

(5) B reads वक्त्रियम्.

महेयद्यन्नपूर्वक यावत्तेपः सुलक्षणते ।
 यवाहं सेपयत्वेव पत्रान् तु यन्नपूर्वकम् ॥ ११ ॥
 क्षायाशुष्के च संजाते दापयेष्वभिसंपुटे ।
 चृढाखो सेपयत्वेव सम्भो यदेन सुद्रयेत् ॥ १२ ॥
 मेन्नितो माषगोधुमो पिष्टसेपं प्रदापयेत् ।
 क्षायाशुष्के च संजाते मृशयं सेपं दापयेत् ॥ १३ ॥
 सुशुष्के च गजे पाण्डं स्वाक्षर्योत्तं ससुचरेत् ।
 जायते उच्चवलं वद्धं वातशुष्कं तु कारयेत् ॥ १४ ॥
 यः वाचित् मूर्च्छित्वेव^१ वीवयेष्वीवनक्रियाम् ।
 स हि वद्धाशयेष्वेव^२ उच्चवलः कठिनो^३ भवेत् ॥ १५ ॥

- (1) वावत्तेपम् वावत्ते, a variant, which seems to be incorrect.
- (2) वद्धकम्, a variant in A and B.
- (3) वावत्तीते, a variant in A and B.
- (4) व वाचित् मूर्च्छते ते च, an incorrect variant in A and B.
- (5) वाचित्वावत्तेप, a variant in A and B, which is unintelligible.
- (6) A and B read वावत्ते कठिनं, which is incorrect.

अतिशुद्धतरं तत्र आयते नाव संशयः ।
 सर्वकर्मजारं चेष्ट नानाभागेन पुर्णितम् ॥ ६६ ॥
 भोगभागसमायुक्तं वह्नि च गुणसंयुतम् ।
 सत्त्वार्थे^१ धनार्थे च संयोगे साधयेत् सदा ॥ ६७ ॥
 आयते सुभगं तत्र संसारे शोभनं भवेत् ।
 अनेनैव प्रकारेच आयते धनसम्पदः^२ ॥ ६८ ॥
 पावस्तुवाच ।
 एषी शुद्धतरं जाते का क्रिया वद मे विभो ।
 सत्त्वार्थे धनसंपत्तेः क्रिया या च पृथक् पूर्वक् ॥ ६९ ॥
 महादेव उवाच ।
 सत्त्वार्थे^३ च नारीकां भिक्षा भिक्षेन वर्तते ।
 अनेका धनदा विद्या आयते सुभगा महत् ॥ ७० ॥
 अतीव शोभना सा च गुणसामर्थदायिका ।
 येन विज्ञानमाचेच साधके धनसुत्तमम् ॥ ७१ ॥

(1) B reads भवतार्थे.

(2) वह्नार्थे is omitted in B.

(3) आयते धनसंपत्ता, a variant in A and B.

(4) A and B read भवतेन.

जायते नैव सम्देहो चनकामर्चंकं महत् ।
 अतिस्रोभाग्वसम्पत्तिर्जायते नाव संशयः ॥ ७२ ॥
 आनयेत् शुद्धं सं वहुं गासयेत् टहुंकः सह ।
 पिष्ठाकसुरसे दिव्ये ठालयद्यबपूर्वकम् ॥ ७३ ॥
 सतदाक्षते शुद्धे कठिनं रजतोपमन् ।
 जायते नैव सम्देहः पुच्छिते रजते शुभे ॥ ७४ ॥
 रजतं जायते शुद्धं संभारं कारयेत् सुषीः ।
 अन्येष्वेव विधिर्द्वयो दिव्यरजतसंभवः ॥ ७५ ॥
 आनयेत् शोधितं वहुं तदेहं पारदे छलेत् ।
 निधायः शोभने खले तुर्यांशे दापयेत्ततः ॥ ७६ ॥
 महयेत् कन्यकावीर्यं यामं शोढ़य यद्यतः ।
 हंसपद्मा रसे दिव्ये तक्षमं महयेत् सुषीः ॥ ७७ ॥
 समानाष्ठरसैनैव महयेद्यबपूर्वकम्³ ।
 कायाशुद्धे च⁴ सुजाते शोषान्ते वासुके पचेत् ॥ ७८ ॥

- (1) दिव्यादिव्यं रजतहं वा, a variant in A and B.
- (2) A and B read निधाय or निधाय.
- (3) वरपूर्वकः; a variant in A and B.
- (4) कायाहन्ते, a variant in A and B.
- (5) A reads शोषाति. B reads शोषाति.

अनेनैव प्रकारेष क्रमादन्ति' प्रदापयेत् ।
 पहराएकेऽष्टकेनैव विशारं हठं दापयेत् ॥ ३८ ॥
 जायते च रसं दिव्यं भक्षणे च सुधासमम् ।
 नारौषा दापयेद्यद्यत्रे मंयोगे नागकेसरैः ॥ ३९ ॥
 तदर्हाः सुहुँ गोधूमाः सहैवं तोलकार्डम् ।
 अतिसौख्यकरं तज्जुँ रज्जिमादादेव वर्द्धते ॥ ४० ॥
 पुंसि अजगुणोपेते यथा च गंधकी गतिः ।
 नरादेव भक्षणे यातो जातिवयसमन्वितः ॥ ४१ ॥
 अनेनैव प्रकारेष क्रमेण वर्द्धयेद्वसम् ।
 जायते रसजा सिद्धिः नाच कार्या विशारदा ॥ ४२ ॥
 सुक्षत् सुधाकरं वज्रं गालयेद्यद्यपूर्वकम् ।
 तज्जलं शोषयत्येव शतांशे रसदापिते ॥ ४३ ॥
 रजतं जायते शुद्धं कसाहाविंशतः स्फुटम् ।
 अन्यै वै मेलयत्येव विक्रये शुभदं महत् ॥ ४४ ॥

(1) A reads नाचकेसरै.

(2) B reads विपु.

(3) A and B read ते च, which is incorrect.

अनेनैव प्रकारिष्व जायते धनसंपदः ।
 साधयेत् सिद्धिदा विद्या देहसामर्थ्येदायिनी ॥८॥
 मेत्येदभोगभागेन भृत्याहरदो विधिः ।
 पीते भावनया अम्बो^१ सार्वहुतेन सिद्धयेत् ॥ ८७ ॥
 यहताम्बे प्रदातव्यं यतायि हाटबोतमम् ।
 जायते नाच सम्बेदो यथा जाम्बुनटोऽवम् ॥ ८८ ॥

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पार्वत्यवाच ।

ताम्बं च तुत्यर्ज दिव्यं जायते केन विज्ञियाम् ।
 वद विज्ञेय्यर यस्तो सिद्धिं ताम्बविज्ञानकौम्^२ ॥१४॥
 महादेव उवाच ।
 शुचु शुचक्रिया दिव्या तुत्यताम्बस्तु सुधावाम् ।
 येन विज्ञानमाचेष्व साधयेद्रसुकुम्भिकाम् ॥ १५ ॥
 साधयेत् पश्चामृतं दिव्यं महासौख्यप्रदायकम् ।
 ज्ञात्वा कालेन कीयेत संसारसुखभाजने ॥ १६ ॥

(1) A and B read रसी, which is incorrect.

(2) विद्या वामविज्ञानम्, an incorrect variant in A and B.

चानयेत्तत्वकं दिव्यं पौत्रगम्भकसम्भवम् ।
 दापयेच्छोभने रहो अकंचीरिष भावयेत् ॥ १३ ॥
 मर्हयेद्यज्ञपूर्वेच याममावमष्टितम् ।
 तेनैव धातुयोगेन सुवर्चे सुखभता व्रवेत् ॥ १४ ॥
 एताद्यो परा धातुर्वर्त्तते धातुमंध्यमा ।
 सुखभा युभदा प्रोक्षा मम साक्षिध्यना सदा ॥ १५ ॥

पात्रस्युवाच ।

ये गुणा नागजे ताजे वट विश्वस्त्र वहम ।
 प्रयोजनवस्तु यज्ञं चतुरेषेव चोदितम् ॥ १६ ॥
 महादेव उवाच ।
 चनेका गुणा^१ नागेषु पूर्वसुक्षा हि पारदे ।
 विश्वित् घेषतरा ये च शृणु देवि प्रयत्नतः ॥ १७ ॥

(1) A reads वामवाद मर्हयितः. B reads वामवादे मर्हयितः.
 (2) A and B read शृणु.
 (3) चनेका॒ गुणा॑, a variant in A and B.
 (4) शृणानि पारदे, an incorrect variant in A and B.

गागस्त सम्बर्त ताम्भं मध्ये भिकापलं छतम् ।
 विभागे तु छाने तच्च जायते कुम्भिका शुभम् ॥ ८७ ॥
 तच्चाख्ये गासयेकागं विवारं यद्यपूर्वकम् ।
 जायते निर्धार्तं स्वर्णम् उदितं चेष द्विम्बिके ॥ ८८ ॥
 विभागे साम्भातं दत्त्वा अमृतं जायते शुभम् ।
 उत्तरकार्यकरायैते नाम्यदा वस्त्रं मम ॥ ८९ ॥
 तत्त्वात् साधयते दिव्यं भूमागोऽवजं शुभम् ।
 अनेका साधयेद्विद्या रससामर्यदायिका ॥ १०० ॥

Colophon in A

इति श्रीबद्रयामस्ते उमामहेश्वरसंवादे सुवर्णवल्ले
 सुवर्णप्रशंसा नामाभ्यायः ।

Colophon in B

इति श्रीबद्रयामस्ते उमामहेश्वरसंवादे चातुर्मंजर्यां
 सुवर्णप्रशंसा समाप्ता ।

(१) A and B read ते च, which is incorrect.

Extracts from
SUVARNATANTRA
 or
SVARNATANTRA.

सुवर्णतन्त्रात् वा स्वर्णतन्त्रात्

उद्गृहाः श्रोकाः ।

A = MS. from Benares. *

B = MS. from Ramnākali's matha, Dacca. †

श्रोगचेष्याय नमः ।

श्रीराम उवाच ।

देवदेव महादेव ऋद्धिदुष्टि फलपद ।

पूर्वे संचाचिता छट्ठो रसायनपरा परा ॥ १ ॥

यस्माः साधनमात्रेण छाराद्दत्तुष्मो नरो भवेत् ।

तां सिद्धिं वद मे देव यदि त्वं भक्षयस्मुखः ॥ २ ॥

* The name of this MS. is **सुवर्णतन्त्रम्**.

† The name of this MS. is **स्वर्णतन्त्रम्**.

पूर्वं तु कवितं देव रहतवां स्वया मम ।
 गुटिकाः कविताः पूर्वं सहस्रदितयं शिव ॥ १ ॥
 पारदाः कविताः पूर्वे घट्यतं सूतिरूपकाः ।
 धातूनामष्ट कल्पास्तु पूर्वमेव प्रकाशिताः ॥ २ ॥
 धातुयोगास्त्वकल्पस्तु पूर्वमेव प्रकाशितः ।
 रहाना करणे तत्वं पूर्वमेव प्रकाशितम् ॥ ३ ॥
 किन्तु स्वर्णास्त्वतत्वं तु न ममां कवितं प्रभो ।
 कश्चपेन महेशानाभ्यदितोऽस्मि महेशर ॥ ४ ॥
 भूमिदानं मया दत्तम् ज्ञापये कश्चपाय वै ।
 कश्चपेन मयि प्रोक्ष्य भूमिभागं स्वज्ञ प्रभो ॥ ५ ॥
 क्षानायं तु महेशान रक्षाभ्यः प्रार्थितो मया ।
 काष्मात्रं स्वसं तेन दत्तं मम महेशर ॥ ६ ॥
 क्षानं प्राप्तं महेशान भक्षणं मम नास्ति वै ।
 भक्षणं देहि मे देव यदि पुच्छोऽस्मि शहर ॥ ७ ॥

शैवर उवाच ।

शृङ्ख राम प्रवक्षामि रहस्यातिरहस्यकाम् ।
 शर्यतव्याभिर्तं तत्वं कल्पकपेत् कर्त्तते ॥ १० ॥

॥ १८ ॥ एवं विद्युता विद्युता विद्युता विद्युता ॥ १८ ॥
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॥ २१ ॥ एवं विद्युता विद्युता विद्युता विद्युता ॥ २१ ॥
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॥ २५ ॥ एवं विद्युता विद्युता विद्युता विद्युता ॥ २५ ॥
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॥ २७ ॥ एवं विद्युता विद्युता विद्युता विद्युता ॥ २७ ॥
॥ २८ ॥ एवं विद्युता विद्युता विद्युता विद्युता ॥ २८ ॥
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॥ ३० ॥ एवं विद्युता विद्युता विद्युता विद्युता ॥ ३० ॥

सप्तधा प्रस्वर्हं राम त्वेषं विश्विनं भृतम् ।
 उरितासो सूतिमेति निर्धूमो आयते भृतम् ॥ २० ॥
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 तत्तासं चाषधाती तु दद्याहृते स्तते सति ॥ २१ ॥
 सर्ववेष्टी भवेदेव शतविहो भवेत् सुत ।
 तत्तैसं तु समादाय ताम्बद्रावे विनिच्छिपेत् ॥ २२ ॥
 तत्तचयात्ताम्बवेषः स्वात् दिव्यं भवति काञ्छनम् ।
 वहे कांस्ये यदा दद्यात्तदा रोप्यं भवेत् सुत ॥ २३ ॥
 ताम्बे लौहे तथा रोम्या तारे खर्परसुतके ।
 तत्तचयात् वेष्टमायाति दिव्यं भवति काञ्छनम् ॥ २४ ॥

• • • • • •

ग्रंसद्रावस्य भेदान् हि तत्कल्प्यान् गृह्ण माम्यतम् ।
 लौहद्रावस्यादा ताम्बद्राववेष द्वितीयकः ॥ १ ॥
 ग्रंसद्रावस्यतीयः स्वात् चक्षतास्तद(?) चतुर्थकः ।
 दद्याद्रावः पश्चमः स्वात् चक्षवेष्टी तु मष्ठमः ॥ २ ॥

* The above 24 Slokas are not found in MS. A.

पञ्चाना तु परीक्षा वे कथ्यते शृणु मान्मतम् ।
 सौहस्रौं समादाय सौहस्रावे विनिश्चिपेत् ॥ १ ॥
 तत् चण्डाहवतां याति सा सूचो नाद संशयः^१ ।
 ताम्बद्रावे तथा सूचौं सम्भिर्मैदौं विनिश्चिपेत् ॥ २ ॥
 सूचौद्रावो याम्भानादभवत्वेव न संशयः ।
 ग्रन्थसूचो ग्रन्थसूचो चतुर्यामिन संदर्शेत् ॥ ३ ॥
 दम्भासोऽधो^२ यदा गच्छेत् दम्भासाम्भा भवन्ति हि ।
 दम्भद्रावोऽप्यधो गच्छेददम्भद्रावो भविष्यति ॥ ४ ॥
 एवं परीक्षा छत्वादौ प्रयोगानामिद्वृवन् ।
 वज्रमूषा ततः छत्वा ग्रन्थसूतं विनिश्चिपेत् ॥ ५ ॥
 सौहस्रौद्रावरसं तत्र यद्देन निश्चिपेत् ।
 तत्राम्भिं दापयेदयनात् पुनस्त्रव^३ रसं श्चिपेत् ॥ ६ ॥

(1) The above 7 hemistiches are not found in A.

(2) A reads दंतासाधी. B reads दक्षासाधी. Both the readings seem to be incorrect; since B has उक्तासाध चतुर्वक्षः in the 2nd Sloka.

(3) B reads ग्रन्थम्, which is not correct.

स सूतो शुतामिति^१ नाव कार्या विचारता ।
 अष्टधातुपु तं सूतं दत्ता काष्ठनतां लब्धेत् ॥ ८ ॥
 तं सूतं भवेद्यो हि सोऽमरत्वमवाप्न्यात्^२ ।
 तथा गूदपुरौचेतु शूलं^३ भवति काष्ठनम् ॥ १० ॥
 ताम्बद्रावप्रयोगं वै शूलं यद्देन साम्भातम् ।
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Colopbon in A—इति श्रोतुवर्णतंत्रे हरपार्वतीमंवादे
 दुष्कर्णाकर्त्त्वः हितौयः ।

Colopbon in B—इति श्रणतंत्रे सोऽहद्रावादिपश्च-
 फसकर्त्त्वो हितौयः ।

- (1) B has का शूली वर्तिनाहृति.
- (2) A reads उ वचेद्यवरत्वात्, which is incorrect.
- (3) B reads गूदम्.
- (4) यहताम्बे तु निचिपेत्, a variant in B.

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